MOTT MACDONALD

NAIMCR Estudio de Emplazamiento y Plan Maestro

Executive Summary

May 16th 2017

COCESNA

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Contents

1 Glossary of Terms.

ACRP-Airport Cooperative Research Program

ACI-Airports Council International

ADRM-Airport Development Reference Manual (IATA)

AHP-Aeronave Hora Punta (Peak Hour Aircraft)

AIJS-Aeropuerto Internacional Juan Santamaría

CAT I- Category I

DGAC-Dirección General de Aviación Civil

FAA-Federal Aviation Administration

GAM-Gran Región Metropolitana (Great Metropolitan Region)

IFA-Índice de Fragilidad Ambiental (Environmental Fragility Index)

MARS –Multiple Apron Ramp System

MIDT- Market Information Data Tapes (Traffic Database)

MPPA – Millions of Passengers Per Annum

NAIMCR- New International Metropolitan Airport for Costa

NFPA-National Fire Protection Agency (USA)

MD-Maximum Development

OACI-International Civil Aviation Organization

OP-Public Works

APP-Public Private Partnership

PIB-Gross Internal Product

RPK – Revenue Passenger Kilometre (Traffic measure)

SEI-Crash Fire and Rescue Service

TRB-Transport Research Board

ZE-Implementation Site

2 Introduction

The Contract No. 03-2015 PG-COCESNA, hereinafter the "Agreement", was signed on the 16th of May 2016, between COCESNA, and Mott MacDonald Limited. Mott MacDonald has been supported by a team of recognized consulting companies in the sector. These companies include the Costa Rican firms Gensler Architects and FSA and the Spanish consultant EnRoute

The contract signature and project kick-off was formalized on May 18, 2016 (OFICIO PE 060-2016). According to the Contract and the schedule presented by Mott MacDonald, the maximum duration of the contract provided for in the contract is twelve (12) months. These are counted from the signing of the order of commencement of the consulting contract, up to the delivery of the final report, no later than May 17, 2017.

The purpose of the Contract is to prepare a Feasibility Study and Master Plan for the Nuevo Aeropuerto Internacional Metropolitano de Costa Rica (NAIMCR), to be built in the canton of Orotina, Provincia of Alajuela. This region was designated by several previous studies as the most suitable area for the construction of the new airport of Cost Rica, which will replace the current Juan Santamaría International Airport (AIJS).

The new airport can be defined based on 6 different elements that shape the demand and impact on the development of the airport for the future. These six elements are key to take advantage of the potential development of the airport that must serve as a tool for the country's development.

Figure 2.1: Key aspects to define the new Aeropuerto Metropolitano

Source: Mott MacDonald

Considering these aspects, the vision and objectives of this project have been clearly defined as below:

The new airport of Costa Rica should become a key factor for the country's growth and the implementation of the vision for a green and sustainable future for Costa Rica. It should also improve the international connectivity of the airport and help to consolidate the metropolitan area of San Jose with the rest of the country.

To convert the airport into the flag that shows the general objective of national development for Costa Rica.

To promote Costa Rica as a sustainable air transport development center for Central America.

Airport to attract new foreign investment aspiring the role of logistics center for Central America.

Physical and urban development of the airport integrated into the territory and its environment.

Favoring the creation of local employment and promoting the appropriate training for the different employment profiles.

Construction of the airport following criteria of sustainability and seeking to integrate the suitable technologies for its efficient operation.

With regard to the master plan it is possible to say that:

The Master Plan *should be conceived as a flexible, coherent and comprehensive guide, designed to implement the mission of providing the necessary aeronautical infrastructure and realizing the vision of the country. The Master Plan should be read and understood as a living document, a reference for administrative management, being more a general approach of direction, guideline and maneuver than an inflexible plan. It contains options and phases, presenting realistic construction and investment programs that are conceptually and practically feasible, which are open to the consideration of alternatives that will be decided at the last design stage according to the most appropriate technology at that moment.*

The Master Plan has to be prepared with ample flexibility to respond in an agile and direct way to the requirements of the country's growth, depending on the behavior of demand, regional competition and technological advances in the field of aviation.

In this sense, the behavior of the demand of passengers and cargo will be the factor determining the programming, execution and speed of the investment stages that are proposed. The implementation of this Master Plan is governed more by the behavior of the market, transportation technology and competition, than by specific scheduled dates.

The project, which is fully aligned with the country's future vision and growth strategies, will serve as the basis for the investment decisions to be adopted by the Government of Costa Rica for the new international airport of the country. It is expected to unite the political wills to declare the public interest for this project in the selected area and to initiate the subsequent processes that mainly involve the acquisition of land, its preparation by executing the earthworks, and the facilitation of access and services to the site.

It is to be noted that, after meteorological and aeronautical studies, the consulting team confirms the previous studies and develops the predicted location of the airport in the canton of Orotina as the most convenient and feasible option.

Figure 2.2: Project localization

Source: Mott MacDonald

Figure 2.3: View of the site

Source: Mott MacDonald

The Project has been structured in the following activities according to the Scope of Services:

- Activity 1. Inventory of current conditions and initial meetings
- Activity 2. Estimation of air demand.
- Activity 3. Preliminary Engineering Study and Environmental Assessment
- Activity 4. Analysis of requirements
- Activity 5. Conceptual Development Alternatives
- Activity 6. Airport Development Plan
- Activity 7. Preliminary Business Plan

The final report can be divided into three thematic sections. The first one deals with t existing conditions as well as the market conditions and its future projections, taking into account the geographical and environmental aspects that might affect the development of the project.

This stage of the project was developed primarily during 2016 and comprises activities 1 to 3.

The second stage is the master planning phase itself. It starts with the analysis of the requirements (as a function of the expected demand), and ends with the conceptual development of the alternatives and the different options to satisfy the demand.

Once the most favorable and convenient alternative is selected, the final phase consists of the planning the development in stages generating the corresponding plans that serve as a graphic expression of the infrastructure that results from the operational requirements.

Finally, the last stage, condensed in activity number 7, includes the economic expression of development. That is the fundamental basis of the feasibility of the project and the guide for the political and budgetary actions of the Government of Costa Rica in pursuit of the desired development.

The activities have been developed following a strict mechanics of workshops. These took place at least once a month, involving the consulting team and a technical commission composed of members of civil aviation who participated throughout the process under the guide of the Sr. Delegate of Costa Rica before COCESNA, Dr. Carlos Segnini and the Sr. Vice-president of COCESNA, Dn. Eduardo Montero. We thank both for their contribution during the debates as well as for the constructive criticism exercised in the framework of their functions.

Below is the executive summary activity by activity.

3 Activity 1. Inventory of Current Conditions and Initial Meetings

This technical report has been the first of a series of reports which are integrated in the final report of the "Survey of the Site and Master Plan" of the new airport.

It is important to note that, with the exception of geotechnical and topographic data obtained through measurements and studies carried out by the consultant itself, an important volume of information has been obtained from other sources (in general, organisations belonging to the Costa Rican Government). The consultant has accepted the accuracy and correctness of the data obtained from these sources.

The collection of initial data has been organised as per the following topics:

- Topographic data of the implantation site;
- Soil study and geological characterisation;
- Meteorological and wind data;
- Structure and management of the airspace;
- Data on properties and land uses within the development area;
- Data on support infrastructure for connection with the NAIMCR area;
- Applicable legislation and regulations as well as boundary requirements;
- Socio-economic and demographic data for the region.

First, the consultant team focused on topographic studies. These were carried out with the required precision to be able to correctly evaluate the best alternatives for the implementation of the different components of the airport infrastructure. Special attention has been given to meteorological conditions, surrounding obstacles and earthworks using a digital terrain model for construction, based on the topographic data collected. This part of the report provides information on the methodology, the equipment, and the results. The information is presented using one meter contour levels to allow for a better appreciation of the site's topography.

The characteristics of the terrain were then evaluated by means of various types of geotechnical studies such as geo-seismic, penetration, extraction of samples by percussion and rotation, as well as determination of permeability. These studies, along with the geological characterisation included in the report, are used to make recommendations on buildings' foundations based on the soil bearing capacity, to make appreciations regarding earthworks, in particular by determining the methods and equipment that will be necessary to perform earthworks, to study the runoff of the site and ultimately to inform the development strategy of the infrastructure and the resulting costs.

The recommendations have been added as an additional appendix. To summarise, we can say that the soil and geology of the area have uniform characteristics and the initial views are that it should not present any particular difficulty in order to develop airport facilities in this area. In addition, earthworks should not interact with rock formations that require the use of explosives during the earthworks.

Meteorological and wind data has been the main concern of the consultants since the inception meeting and therefore efforts have been made to obtain all the data available in relation to the site. It has been recognised that a stage has been reached where all the available data by direct measurement has been collected, and it has been agreed to elaborate a wind rose which is

assumed to be best estimate of frequencies and wind intensities based on the available information.

Basic available meteorological information is included in this report, although it is not ruled out that the installation of new meteorological stations, as happened during the execution of the contract, or interpolations from mathematical models, can shed new light on the subject and lead to modifications to the work carried out based on this data. During the contract, it has been verified that there has been no evidence of a meteorological event or data, however small, that would lead to question the validity of the information mentioned above and all the data to date tends to justify the decisions in the report.

The structure and management of the airspace is important for the determination of approach and landing operations for the NAIMCR. For this reason, the data collected and recorded in this section of the report will serve as a basis for the airport operation planners and will be used to determine the capacity of the airport. It is not ruled out that based on what has been relayed and in agreement with the DGAC, modifications to the organisation of the airspace must be proposed later. These modifications have also been discussed in different sections in the report.

Cadastral and land use data within the proposed airport area inform of the impact on communities and the ecosystem, the cost of expropriations, the modification to urban zoning and in general, on the interaction of the proposed airport with its urban and social environment. For this reason, a section of this report has been dedicated to the topic, recording these elements at the date of the study and based on data provided by official bodies.

Similarly, the inventory and evaluation of surface access infrastructure is of importance, with an emphasis on road access which concentrates most of the available means of communication between the future airport and San José. Due to this, this report assesses not only the current situation and the capacity of the existing roads but also describes plans for the development of sufficient road infrastructure.

The report also evaluates in parallel surface access needs using buses, the current state of the rail network and the potential for it to become a suitable mode of transport to access the airport

Finally, it is important to mention in the initial inventory an evaluation and listing of the socio-economic conditions and the regulations applicable to the population. This inventory serves as a baseline for evaluating the impacts of the development in the later stage of this work.

4 Activity 2. Traffic Forecast

This chapter describes the methodology used for the aviation traffic forecast at NAIMCR. The basis of the forecast are the macroeconomic conditions that impact on the air traffic. This is the basis to estimate the air traffic demand for the NAIMCR.

The traffic forecast considers the current traffic situation in Costa Rica. Global air transport has been growing over 4% a year in this millennium, and the Latin American market has grown even above average to gain market share of 7% to 8%. Central America, and in particularly Latin America, has also seen significant growth, as evidenced by the recent data from the period 2007 to 2014, where the RPK has increased by over 4.5% with the different world regions. The industry maintains expectations of significant growth for the next 20-30 years, which defines an excellent framework for Costa Rica to take a greater weight in this traffic.

Costa Rica's traffic in mid-2016 shows an annual passenger traffic of 5.3 million passengers. This traffic is channeled through the four international airports, although only Juan Santamaría and Daniel Oduber airports are relevant for commercial traffic. Limón and Tobías Bolaños airports are more framed in aerotaxi service or of regular line of short haul.

The recent historical growth has been important, especially since 2015, where there has been a significant jump that is consolidated in 2016, with growth rates above 15% in both Liberia and Juan Santamaría airports. Juan Santamaría airport represents 83% of the international traffic of Costa Rica, being the most important door of international traffic. This growth is closely linked to tourism and the recent increase in European and American companies that dispute to offer direct services. On the other hand, the volume of aircraft has decreased, partly due to the increase of traffic of large aircraft and the decrease of the activity of general aviation.

In the large GAM metropolitan region, Juan Santamaria has also seen significant growth in recent years, especially since 2015. Clearly Tobías Bolaños airport is an important general aviation base and the debate on the future of these two airports must be resolved. That strategic and operating aspects of maintaining four airports open are to be analyzed. For the consideration of traffic forecast, the GAM is considered as a single destination for international traffic, and the internal metropolitan demand for general aviation air taxi has not been quantified in the projection but may have commercial interest for the future.

Juan Santamaria’s traffic has a large North American share that has remained between 52% - 55% and with 5 routes between the first 10 routes at the airport (Houston, Miami Fort Lauderdale, Atlanta, and New York). The second most important share would be the Central American market, which includes connections to Panama (the most important route of the airport), San Salvador, and Mexico. The other route among the top ten in June 2016 is Madrid, and it is noteworthy that demand and interest continues to grow during the period of this study. It is also important to mention that during this year, the political-macroeconomic environment has witnessed great volatility due to events such as the departure of Britain from the European community, and the election of a president with non-traditional proposals in the United States. The impact of these events on air traffic, positive or negative, will only be correctly appreciated in two or three coming years.

It is therefore important to emphasize that it is common practice for traffic studies to be updated at least every 5 years (i.e. the next update would be in 2021), also there should be another update in 2026 when the NAIMCR is due to open.

The top airlines at AISJ are the Avianca Group and Copa, followed by american companies for long haul. AISJ presents a great variety of companies, including national as well as low cost being this good indicator of its attractiveness. The domestic market is shared between Sansa (62% of operations) and Nature Air.

The seasonality of the demand is accentuated, with the peak season occurring around the end of the year and the month of July. The lowest traffic months are September and October. The difference between the minimum and the maximum is not very large compared to others Tourist destinations, since the minimum is 40% of the maximum month.

Around the 7% of the traffic is transfer. The MIDT database analysis, clearly shows that there are two hubs in the Central American market, the main one is Panama (with more than 9 million passengers connecting in 2015 Over a total of 13.4 million) and the second one is El Salvador, with a peak transfer of 56% in the high season. Part of the AISJ transfer can be explained by the type of route passengers seem to follow, visiting several Central American countries entering one airport and leaving the other.

This analysis carried out during the study defines a clear opportunity for the NAIMCR: A) Development of tourism aligned with the airport; B) Positive environment for the establishment of bilateral agreements; C) Low-cost development linked to economic growth in Central America; and D) Central America and the Caribbean zone attractiveness has increased and posed a renewed global interest, due partly to security issues in other destinations.

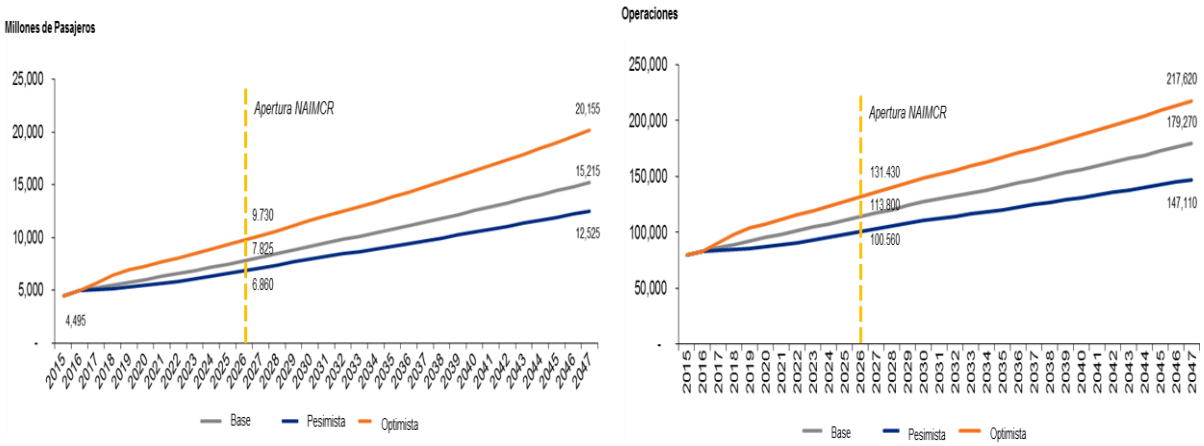
On the other hand, the following threats have been identified: A) Panama Tocumen Airport competition and, to a lesser extent, El Salvador, B) Lack of a Costa Rica-based airline, C) competition from other tourist destinations, and D) Economic situation in Central America and the risk that the Region does not consolidate this moment of growth in commercial traffic.

In this context, a traffic forecast has been developed up to 2047 for the NAIMCR according to the requirements of the Contract. The forecast has been based on an econometric formulation, as this is a forecast for a new airport that expects to open in the medium term (opening in 2026) and it was needed to assess the market trends in the medium and long term.

The current traffic and short-term development strategies have provided the starting point for the projection. The NAIMCR benefits from the recent increase in traffic experienced by AISJ. The countries that make the greatest contribution to air traffic in Costa have been correlated with macroeconomic indicators to reflect the impact on the traffic growth trends in Costa Rica. These indicators in general are correlated with the Gross Domestic Product (GDP) of a given country.

The forecast model considers that the airport can open with a traffic of 7.8 million passengers and arrive in 20 years to the figure of 15.2 million passengers for the Base Case. The optimistic scenario considers a more optimistic GDP growth and a low-cost market development in the short term. The pessimistic case considers that GDP growth is 10% lower and that it also decreases the elasticity of demand. These values give a range of between 6.8 (pessimist case) to 9.7 million passengers (optimistic case) for the year of opening. The range for 2047 would be between 12.5 to 20.1 million passengers for the such scenarios.

Figure 4.1 Annual Passenger Traffic Forecast (left) and Annual ATMs (right).



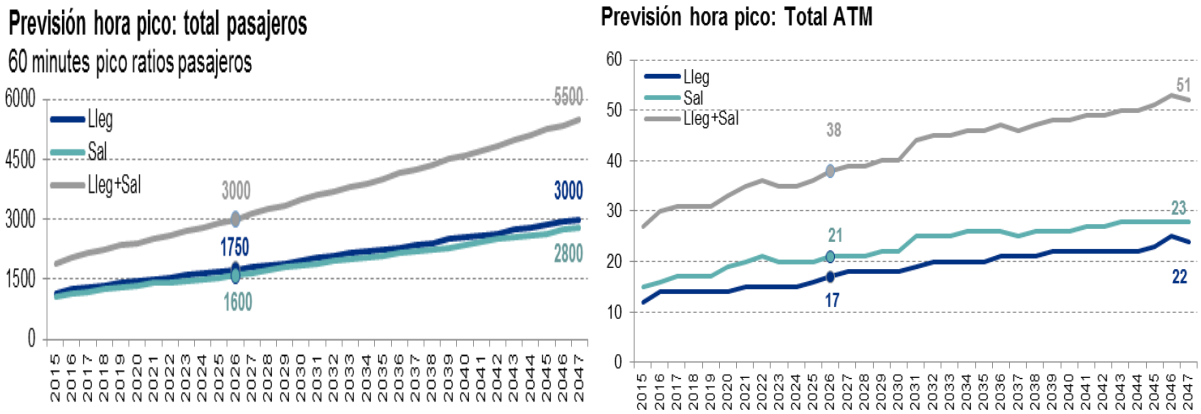
Source: Mott MacDonald.

The figures above include international and domestic traffic. The international traffic is expected to continue to maintain the American share as the main one, with a slight reduction on its quote. Europe and Latin America are expected to maintain their percentage share. The market that is expected to increase significantly its quote would be the Central American one. The remaining markets (Where Asia is included) are expected to grow significantly, but would maintain a minimum weight on the total, around 2% of the share.

The peak hour has also been estimated considering the analysis of the data from 2015. This peak hour is used to estimate the demand and needs of capacity of the infrastructure. This is the base for the estimation of requirements for the Master Plan.

As starting point and based on the formulas developed to correlate the annual demand with the peak hour to reach an opening value of 3000 peak hour passengers, 1750 outgoing passengers and 1600 arrival passengers. The ATMs peak hour would be 38 aircraft-hour, 21 departures and 17 arrivals.

Figure 4.2 Passenger peak hour forecast (left) and Peak hour ATM (right).



Source: Mott MacDonald.

Table 4.1: Base Case – Demand Growth at NAIMCR

Passengers	2015-26	2026-31	2031-36	2036-46
Domestic	4,5%	3,9%	3,5%	3,5%
International	5,2%	4,0%	3,2%	2,9%
Connecting	5,2%	4,0%	3,2%	2,9%
INT - INT	5,2%	4,0%	3,2%	2,8%
INT-DOM	7,1%	5,9%	4,6%	0,0%
DOM-DOM	6,0%	3,1%	2,7%	3,2%
Total	**5,2%**	**4,0%**	**3,2%**	**2,9%**

Source: Mott MacDonald

Table 4.1 above, shows annual % growth for demand adopted for different periods.

As for the cargo forecast, this is based on a market that has recently declined but has an important added value. The AIJSM represents the first point of entry and exit of the country by value of cargo. Significant importance is given to dedicated cargo-only aircraft, which move 75% of the cargo. The traffic forecast result shows 110,810 tons in 2026, reaching 232,980 tons in 2047.

Given the vision of this airport considers that it should not only be the airport for the next 30 years, until 2047, but must be the infrastructure that welcomes the country's air transport well beyond that contractual horizon, the Consultant, with the agreement of the client, has added to its contract a horizon of future development that leads to contemplate the airport development up to a capacity of 50 million passengers per year. This scenario is called maximum development or MD.

As a result, the Consultant has come to consider (depending on the purpose of the planning), up to 6 scenarios as presented below.

- The facility requirements for the NAIMCR are estimated for the opening +5, 10 and 20.
- The MD is a scenario that is strictly unrelated to any specific year. It is developed to ensure the long-term development of NAIMCR. For the MD, the needs of each infrastructure element are determined on a trend basis according to the difference between estimated traffic in 2047 and 50mppa
- Similarly, Phase III is determined for the base case (or more likely) scenario, as well as the optimistic one. The latter scenario, as well as the MD, allow reserves of space and land, however, the areas to be developed would be strictly needed.
- Financial calculations are based on different scenarios.

Table 4.2 Traffic demand scenarios analysed (annual passengers).

	2027	2032	2037	2047	2047	MD
Estado	**Base**	**Fase I**	**Fase II**	**Fase III**	**Fase III**	**Máximo Desarrollo**
Escenario Tráfico	Base	Base	Base	Base	Optimista	Pro rateado en base al escenario Optimista 2047
Pasajeros anuales	7.610.000	9.170.000	10.715.000	14.220.000	19.210.000	50 mppa

Source: Mott MacDonald

5 Activity 3. Preliminary Engineering Studies and Environmental Assesment

Activity 3 summarizes the basic information required for the development of activities related to the NAIMCR site. The report complements and is integrated with the reports of activities 1 and 2. This report includes the conclusions and recommendations of the studies that should be considered at future design stages.

The areas that have been investigated can be divided into two major areas:

- Those that involve the environment in which the work is going to be developed. The "Conclusions and Recommendations" are presented in detail in the technical report. These are the listed below:
  - Conclusions and Recommendations on geotechnics and seismicity
  - Conclusions and Recommendations on hydrological study
  - Conclusions and Recommendations on site wide requirements
  - Conclusions and Recommendations on environment
  - Conclusions and Recommendations on landside access
  - Conclusions and Recommendations on socio-economic issues
- A second group is related to the needs of the operation of the airport and are referred to:
  - Waste Management
  - Water resources
  - Public Service/ Utilities Requirements

This last set of requirements has evolved as the sizes on the subsequent activities of the airport facilities and other parameters have been refined and developed. These complete the final set of facility requirements for the master plan.

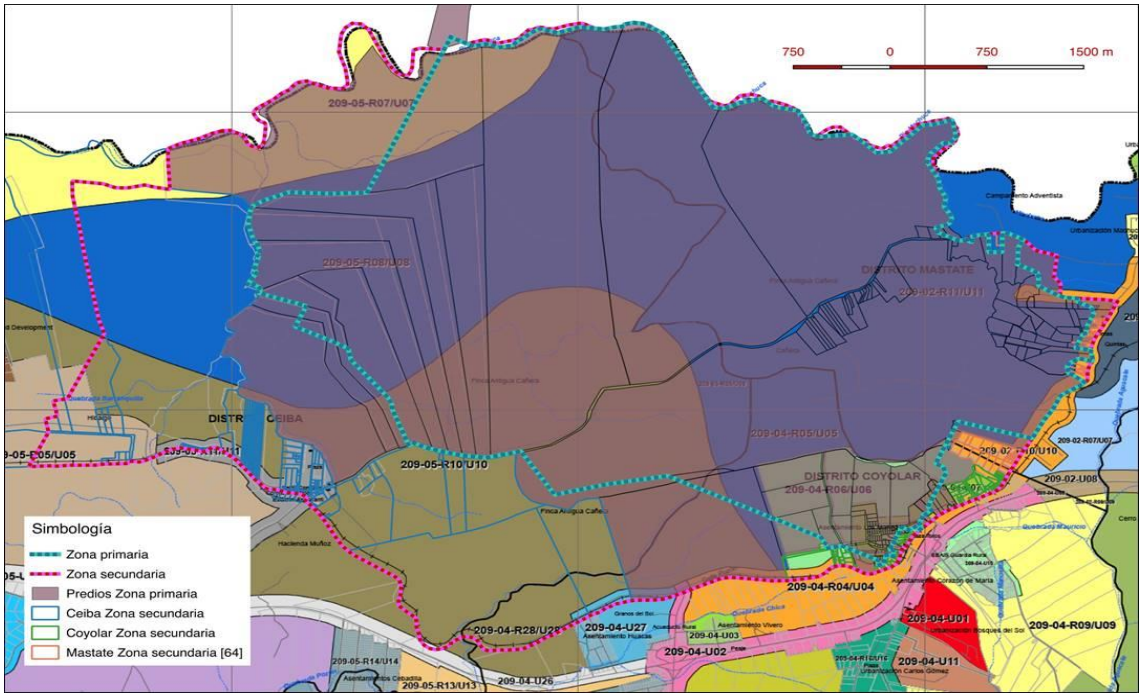
The factors that may affect these preliminary requirements are related to the incorporation of the sustainability criteria as well as the development and more accurate definition of the typology of the facilities while the planning and design stages progress. Ultimately, the technical / economic criteria are an important input to define the solution based on the balance between initial investment costs and operating expenses (this is developed in Activity number 7).

Finally, the report is completed with the appendices that contain the detailed information of the different preliminary engineering studies. These will allow the different experts to have the detail information that led to the conclusions and recommendations indicated by the Consultant.

5.1 Land Use

Two areas have been defined in terms of land use. The primary zone containing the perimeter of the airport itself, and a secondary zone that is of interest for the zoning and urban/industrial development associated with airport activity:

Figure 5.1 Land Area affected.



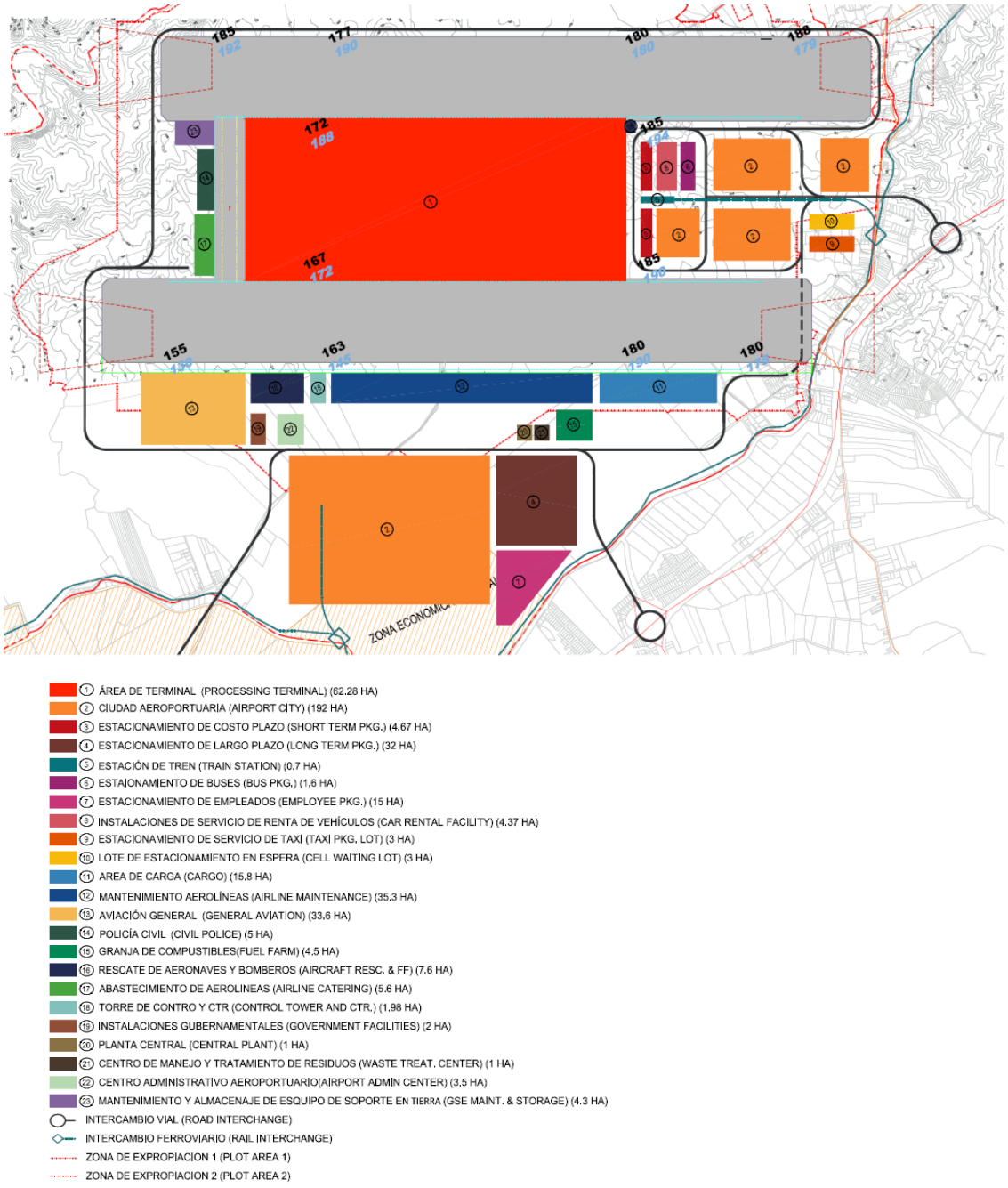
Source: Cocosa. (2016)

The area within the airport boundary has been allocated to different airport related facilities and infrastructure.

A land use map has been developed for each alternative. The setting out of the zoning was carried out based on the fixed runways threshold coordinates.

These coordinates were fixed based on the obstacle limitation surfaces and airspace analysis.

Figure 5.2 Land use plan for one of the NAIMCR alternatives



Source: Mott MacDonald

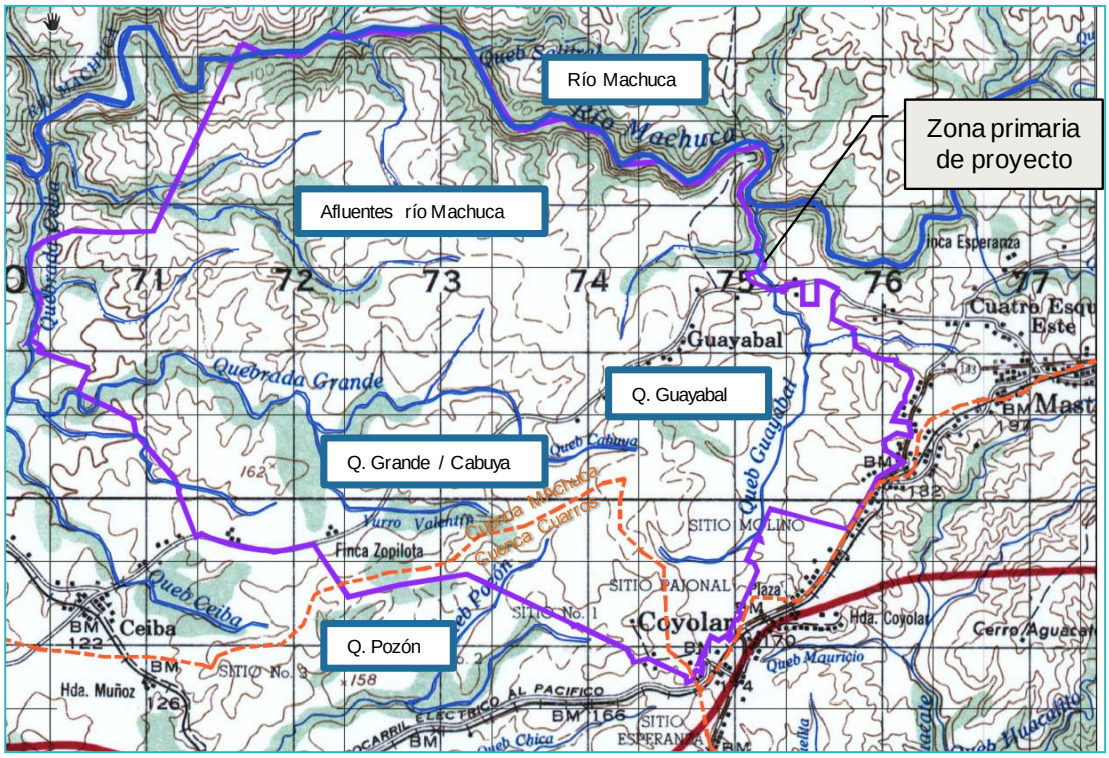
5.2 Environmental and Socio economic study

5.2.1 Hydraulics study

On the environmental issue, the focus was on the streams and water courses and the alteration of the land surfaces that such a vast area entails (large paved surfaces increases the water flow drained from rainwater). The emphasis was also placed on the need for regulation of flows that will prevent flood water and the reuse of water to reduce consumption and increase the sustainability of the project. The main aspects are:

- Machuca river catchment area with deep channels and steep slopes.
- Streams on the site which are low flow, intermittent, channels with lack of definition.
- Guayabal, which is the most polluted.
- Grande, which covers 41% of the area of airport development.
- Ceiba, which is an affluent to Río Machuca
- Need for post project flow regulation

Figure 5.3 Surface water streams



Source: Mott Macdonald based on Barranca cartography 1:50000, IGN.

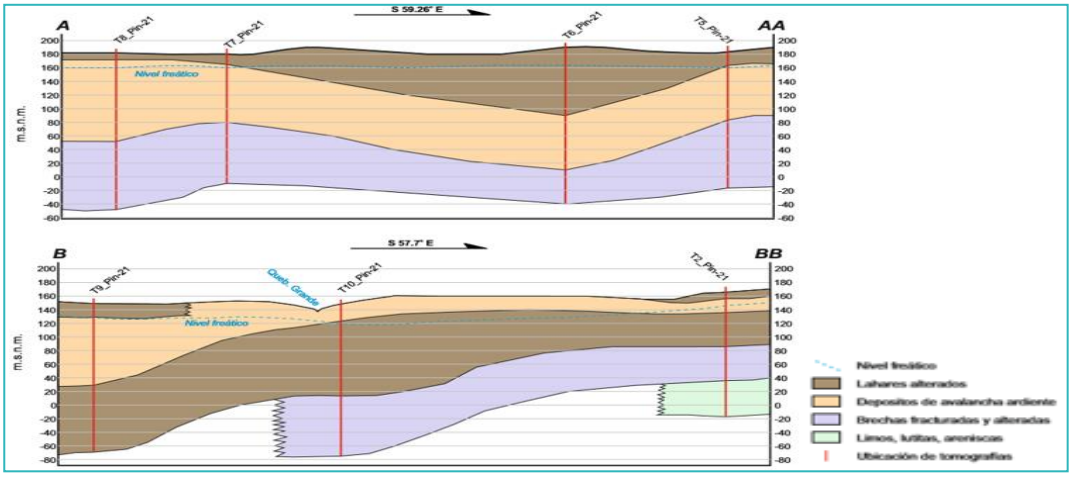
The underground water was taken also into consideration. The availability of water supply for the airport based on the deepest layers has been analysed and deemed feasible.

The use of fuel traps and oil separators is an input to the mitigation of environmental risks in the study. The main conclusions are related to the study of three levels:

- **Top layers- less than 10 m**. Insignificant flow aquifers. Soils types: colluvium, pyroclastic meteoroids or healthy.
- **Intermediate layers: between 20 - 35 meters**. Irregular aquifers, production volume very limited. Low current hydrogeological vulnerability – to be considered when considering excavations.
- **Deep layers: depths of 80-100 meters**. Volcanic fissured aquifer and volcanic with potential to be a producer aquifer.

A network of piezometers could be introduced to control the quality of underground waters, both during the execution of the works and the future exploitation of the airport.

Figure 5.4 Underground water resources



Source: MML

5.2.2 Environmental studies

The biological aspects and sensitive areas affected by development have been assessed, concluding that 3% of the surface is characterized as riparian forest. This contains the largest quantities of variety of flora and fauna in the site.

It is worth mentioning that one third of this area (next to the river Machuca) would only be affected after 2047 once the northern runway is expected to be developed at its maximum length. In this case, it is expected that species un this sector will be transplanted to other areas to preserve them if they are perceived to be in danger of extinction.

The main findings are summarized below:

- The area of study (ZE) is in an area of tropical rainforest (24-30 ° C and 2000-4000 mm rainfall/year) located 2 Km Southeast of the transition to tropical dry forest with a distribution of species from both zones.
- The ZE and surrounding areas are in general, crop areas of pasture for livestock, crops, settlements and cattle ranching activity areas. The index of environmental fragility (IFA) is ranked as low and very low due to human intervention and involvement by human activities causing the fragmentation of the landscape.
- Main ecosystems identified: grassland, riparian forest, secondary forest (regeneration) forest.

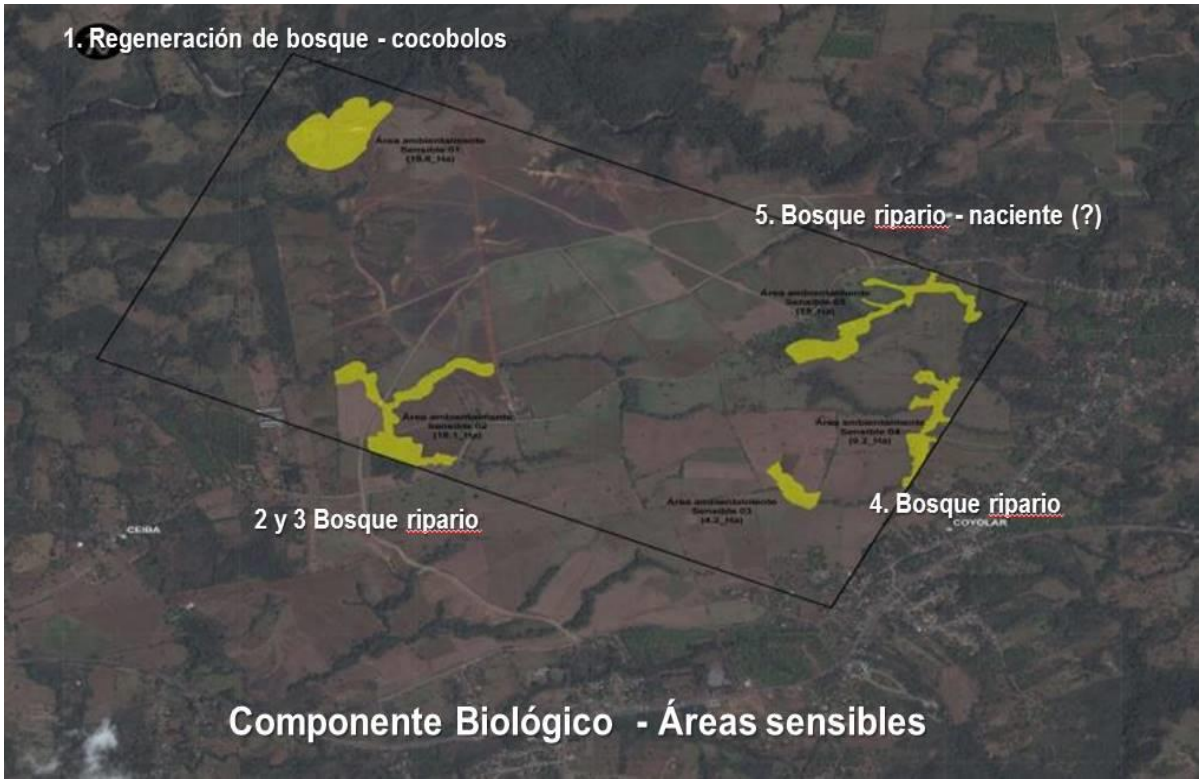
- The largest number of species of flora and fauna were present in the forest and riparian forest.

Five environmentally sensitive areas where defined in the study, covering a total of 66 Ha over the grand total of 1950 HA (3.3%).

The 5 sensitive areas are:

- Regeneration of forest with high presence of cocobolos (19.8 ha)
- Riparian forest (18.1 ha).
- Riparian forest (4.2 ha)
- Riparian forest, (9.2 ha)
- Riparian forest and possible source of water (15 ha)

Figure 5.5 Environmental sensitive areas



Source. MML.

Flora:

- 168 species were identified
- The greatest diversity is found on the sector River Machuca forest

Fauna:

Wet and dry tropical forest species were identified

- 98 species of birds were identified
- 9 species of amphibians were identified
- 8 species of reptiles were identified
- 16 species of mammals (bats 10) were identified

Wetlands:

- In the ZE and its area of influence: streams, yurros and Machuca river (main collector)
- The following environmental sensible areas have not been identified: wetlands of type lagoon, swamps or other lenticas waters
- The following were observed in a very limited way: fishes (Poecilidae) and prawns (Macrobrachium sp.)
- The protected area “Manglar of Tivives” is not affected by the activity to develop and operate the airport.

5.2.3 Social and economic impact

The social impact on the surrounding has been addressed from the point of view of the positive impacts generated by creation of new jobs and the increase of the gross regional product.

These were deducted through methods that compared the jobs that would be generated at the airport, the indirect jobs, and the induced jobs. These were benchmarked against the air transport statistics in Latin America. The estimated total number for 2047 (adding the three categories), would be almost 80,000 jobs. It has been estimated that this would generate a GDP in the order of 1,500 million dollars a year.

Table 5.1 Social and economic impact

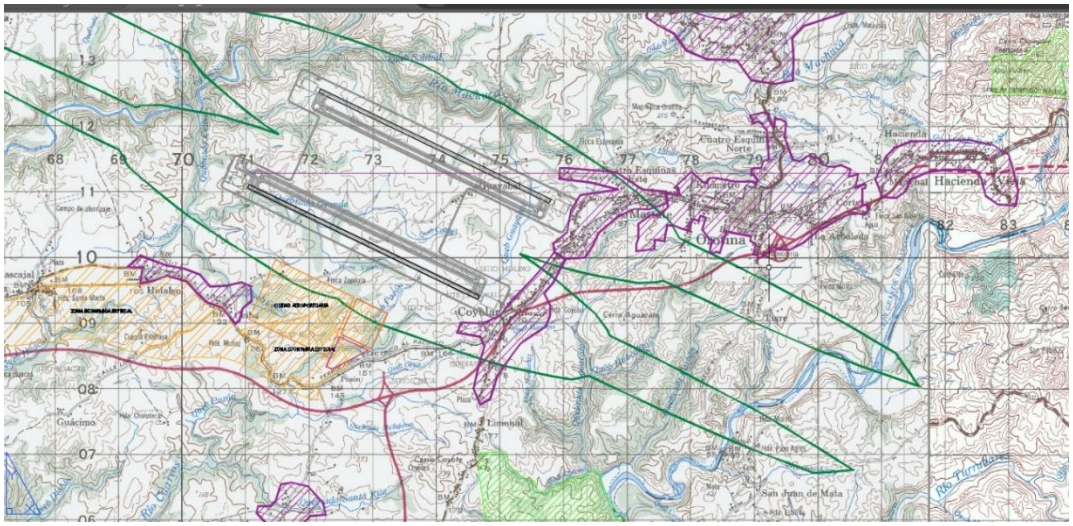
Paises	Abreviacion	Total Pax	Empleo Directo	GDP – Empleo Directo (in US$)	Empleo Indirecto	GDP – Empleo Indirecto (in US$)	Empleo Inducido	GDP – Empleo Inducido (in US$)	Empleo Total	GDP total (in US$)
Costa Rica	**CR**	**3,486,782**	**9,170**	**283,483,267**	**6,790**	**13,732,253**	**1,640**	24,233,219	**17,600**	321,448,740
Brazil	BR	210,978,101	265,000	9,675,000,000	403,000	10,584,000,000	185,000	4,855,000,000	853,000	25,114,000,000
Argentina	AR	29,268,954	72,000	2,491,000,000	60,000	1,834,000,000	37,000	1,115,000,000	169,000	5,440,000,000
Chile	CL	22,181,907	35,000	2,656,000,000	80,000	2,605,000,000	32,000	1,032,000,000	147,000	6,293,000,000
Colombia	CO	57,580,819	65,000	1,203,000,000	62,000	1,061,000,000	18,000	303,000,000	145,000	2,567,000,000
Dominican Republic	DO	11,354,850	8,000	251,000,000	15,000	240,000,000	6,000	96,000,000	29,000	587,000,000
Ecuador	EC	9,988,988	11,000	354,000,000	25,000	339,000,000	10,000	136,000,000	46,000	829,000,000
Peru	PE	22,554,232	27,000	499,000,000	37,000	477,000,000	15,000	190,000,000	79,000	1,166,000,000
Costa Rica 2027 BC	CR 2027	7,610,000	14,256	467,414,014	14,496	220,729,399	5,181	82,637,572	33,933	770,780,985
Costa Rica 2032 BC	CR 2032	9,170,000	16,181	537,003,341	17,411	299,045,788	6,520	118,536,989	40,112	954,586,119
Costa Rica 2037 BC	CR 2037	10,715,000	18,087	605,923,540	20,299	376,609,136	7,847	154,091,219	46,232	1,136,623,895
Costa Rica 2047 BC	CR 2047	14,220,000	22,410	762,276,483	26,849	552,569,998	10,856	234,749,845	60,116	1,549,596,326
Costa Rica 2047 HC	CR 2047 HC	19,210,000	28,566	984,873,112	36,174	803,082,039	15,141	349,581,954	79,882	2,137,537,105

Source: Mott Mac Donald

The impacts that must be mitigated from the social point of view, are summarized as:

- Acquisition of land and involuntary resettlement.
- Modification of the land use and landscape pattern.
- Variation of the demographic pattern and disruption of the social fabric.
- Loss of quality of life by social related issues and environmental impacts (noise in Coyolar / Orotina).

Figure 5.6 Noise Impact for maximum development at 50 mppa



Source: Mott Mac Donald

The view is that none of these impacts has the magnitude for diminishing the positive socio-economic impact of the NAIMCR. However, adequate and prompt action is needed from the Government to apply adequate urban zoning and land owner compensation measures suitable. (According to findings of a workshop held in the municipality of Orotina day 31-01-2017).

It is also required to mitigate the impacts on water resources and biological zones, such as discussed during the project. This would not be in principle significant or to the extent of making the project non-feasible but mitigation measures should be put in place.

1) Surface water

- Direct impact to channels of public domain (diversion / disappearance of channels).
- Potential impact (disappearance) to flows for main streams.
- Alteration of instantaneous flows due to non-permeable surfaces.
- Potential contamination - surface water:
  - Discharges of treated effluents.
  - Spills - fuels, chemicals.
  - Induced development.

2) Underground water streams

- Loss of coverage material - increased vulnerability of lower aquifers - loss of hung levels.

- Involvement of existing concessions.
- Loss of (poor) recharge areas.
- Potential contamination - groundwater:
  - Spills of hydrocarbons and others.
  - Tanks of fuel, chemical warehouses, workshops.
- Increased pressure on resources - involvement of existing concessions - possible exploitation.

3) Biological area

- Habitat loss:
  - Grasslands.
  - Forest.
  - Streams.
- Loss of rare or endangered individuals / veda (No significant presence detected)
- Variation of species distribution patterns.
- Reduction of connectivity (low – the integrity of Machuca river basin is respected).
- Tivives: relative closeness without direct effect. (No particular measure required)

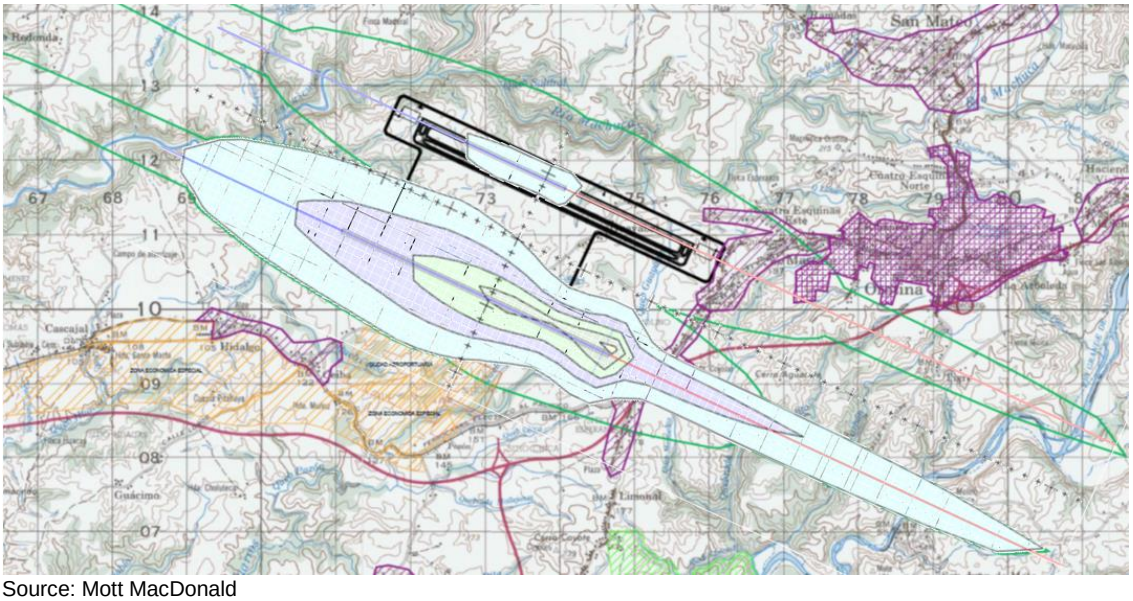
Regulatory plan and urban development

The first point that has been considered during the workshop held in Orotina with the local technical staff in charge of planning, refers to the aeronautical obstacle limitation surfaces. These surfaces are to limit the building heights. Another footprint to consider is the noise level.

For the latter, the zoning where an equivalent noise to 55 dB (following international standards) was shown. It was indicated that construction of schools and health care centres should be avoided in those areas. It was also indicated residents would have to be relocated or offered compensation through the implementation of acoustic insulation for their homes.

It is highlighted that the effects of noise produced by the north runway, which initially would not consider complete extended length, are negligible until the year 2047.

Figure 5.7 Aircraft noise footprints for initial development



Source: Mott MacDonald

To illustrate the impact to the surroundings and the land-use planning, the Consultant showed a set of examples based on exiting airports with a traffic of about 50 million of passengers (Munich and Singapore). The different developments inside and outside the airport grounds and the main services that tend to settle in the vicinity of airport have been illustrated. This showed the type of services that the Consultant would consider inside of what is called the "Airport City", with the land used that the municipality should consider in its urban planning. Some of these factors are:

- Urban density
- Coverage
- Height
- Zoning
- Sustainability

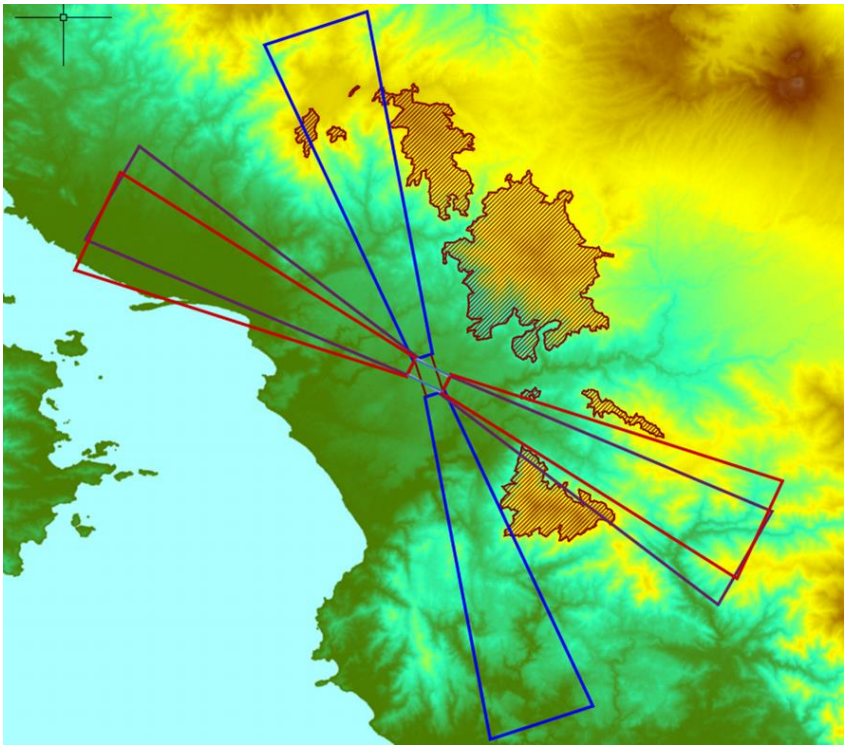
Obstacle Limitation Surfaces

Another impact that has been considered is the obstacle limitation surfaces. These imaginary surfaces are defined to limit the height of the constructions in the surroundings of the airport. These OLSs are defined to protect the safety of the aircraft operations.

The OLSs are defined based on the runways location. The first check is carried out attending to ground penetrations to determine the feasibility of the runway orientation.

The only two feasible orientation for the NAIMCR are shown in the figure below.

Figure 5.8 The only two runway Orientations for the NAIMCR.



Source: Mott MacDonald

Operationally, the 12/30 configuration, as is justified in the report, would be the preferred from the point of view of safety and efficiency of operations.

For the analysis of the runway orientation, the Consultant has considered factors such as:

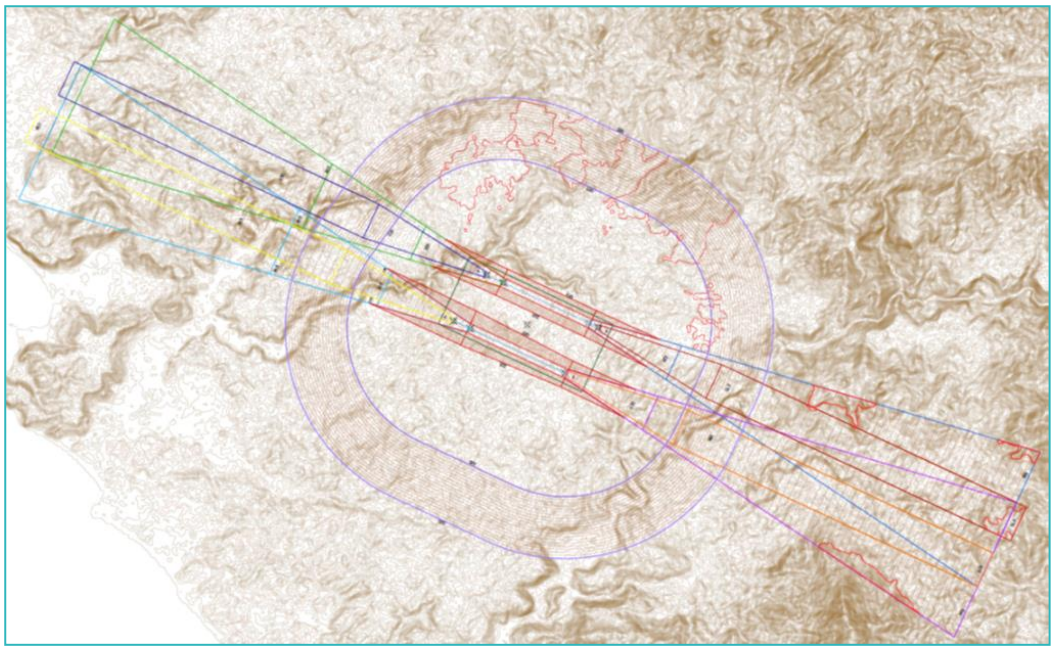
- Wind
- Topography and earthworks
- Availability of land
- Orography and obstacles
- Flight procedures
- Environmental factors and noise impact
- Access and other developments around the airport

After considering all the above, the12/30 orientation is selected as the preferred to take forward.

Based on the runway set out and the aeronautical guidelines, the areas to be safeguarded are defined by the Obstacle Limitation Surfaces considering the following:

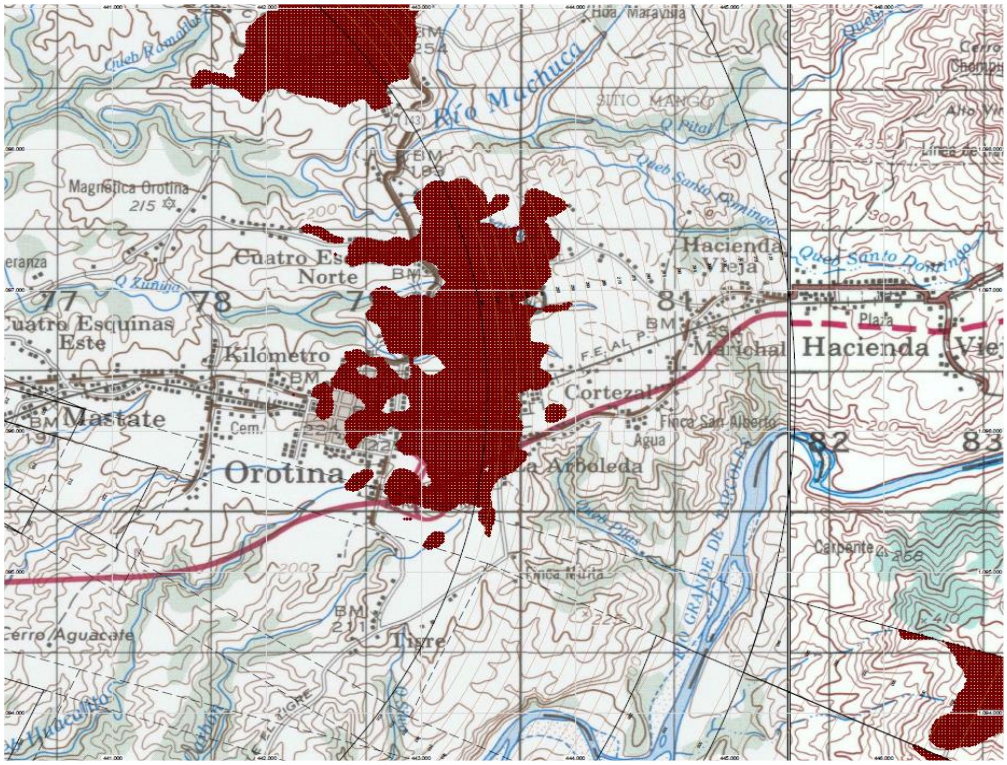
- The Airport imposes restrictions on the heights of buildings, constructions and installations on the surrounding of the airport.
- The obstacle limitation surfaces area defined by international regulations ICAO and applicable to Costa Rica by local standards.
- New constructions that protrude the obstacle limitation surfaces are not allowed except for special cases.

Figure 5.9 Obstacle Limitation Surfaces



Source: Mott MacDonald

Figure 5.10 Obstacle Limitation Surfaces in Orotina



Source: Mott MacDonald

5.3 Landside access

5.3.1 Roads:

A total of 13 sections have been analysed; these were subdivided into subsections:

- Toward the Western Pacific: Liberia.
- Toward the Central Pacific: Puntarenas and Jacó.
- Towards the North zone: San Ramon.
- Toward the centre of the country: San José, Alajuela, Cartago and Heredia.
- Towards the Atlantic: Guapiles.

For each of them, the following was analysed:

- Length.
- Approximate travel time.
- Approximate speed.
- Road capacity.
- Alignment.
- Pavement.

- Condition of the road signs.
- Traffic volumes.
- Intersections to consider and reference pictures.
- Films and videos for reference.

Current and planned investments in roads were also considered and are expected to be executed and completed as a precondition for the airport to be able to operate. In the implementation plan, a review of advances in road development by the MOPT (or the concessionaire) is expected simultaneously with the airport PPP tender releases in order to incorporate firm commitments from the State:

- Expansion of the national route 27 (Ruta 27)

Figure 5.11 National Route 27

Source: Cit. Convias

- Other routes in maintenance and improvements:
  - National routes, 131, 137, 622, 755, 713 and 756.

And also, very important to provide access redundancy is the:

- Construction Road West interconnection corridor:
  - National route 1 to San Ramon.
  - National route 27 to Pozón Orotina

Figure 5.12 West Interconnection

Source: Cit. Convias

For the expansion of the main access, route 27, a reference information was determined to obtain quantitative parameters to obtain generation rates of travel on different modes of transport as follows:

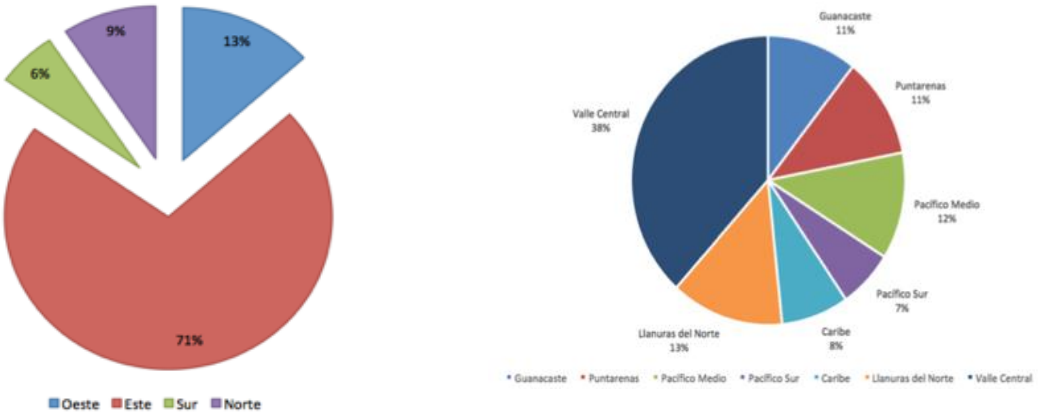
Generation of trips by passengers

First the characterization of the peak hours and type of demand was defined:

- Peak hour 9:00-10:00 am and 3:00-4:00 pm.
- Percentage of vehicles during the peak: 8%
- Modes of transport
  - Bus: 24%
  - Rented cars: 20
  - Private cars and taxis: 56%
    - Vehicular occupation ratio: 1.7
    - Parking usage percentage: 40%

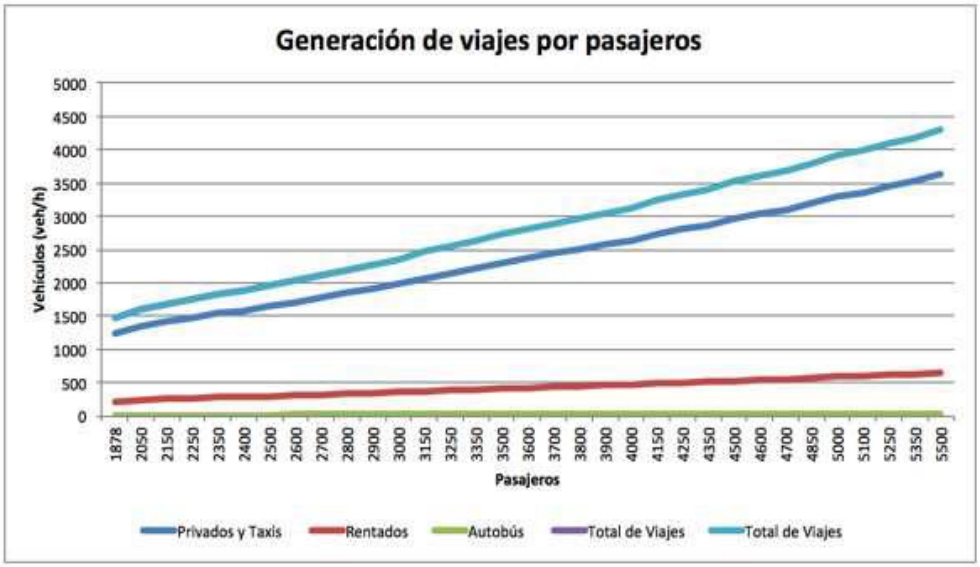
This passenger related demand is classified according to the origin or destination:

Figure 5.13 Passenger destination in Costa RIca: Domestic (left), International (right)



Source: Mott MacDonald

Figure 5.14 Trip generation by passenger type: Domestic (left), International (right)



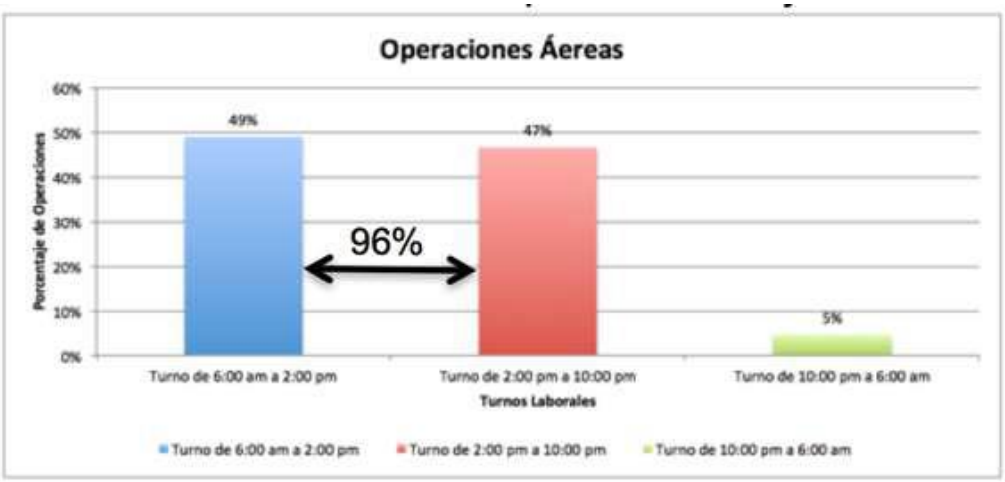
Source: Mott Macdonald

Trip generation by employees

Reference information has been used to obtain qualitative parameters to estimate trips for different modes of transport.

Employees: based on 8 employees for every 10 000 annual passengers, according to the report for Latin America: 2014 ACI Airports' Economics Report and time distribution of shifts in the current AIJSM.

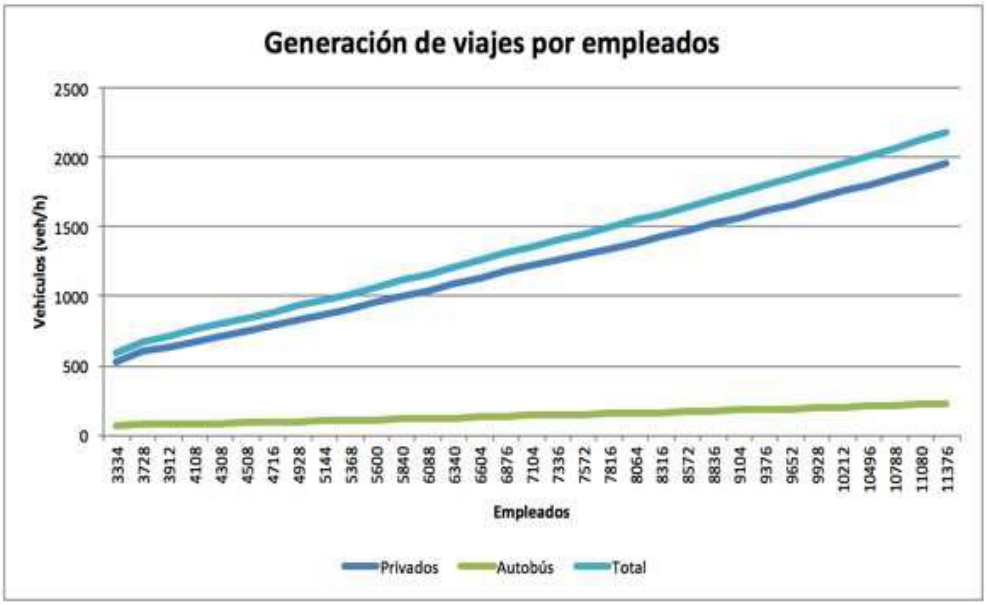
Figure 5.15 Trip generation and Hourly distribution by employees during different shifts based on aeronautical operations.



Source: Mott MacDonald

Vehicle ownership trend in Costa Rica: It is used to understand limitations to the growth of employees arriving in their own vehicle and estimate the trips generated by the employees.

Figure 5.16 Trip generation by staff (empleados).

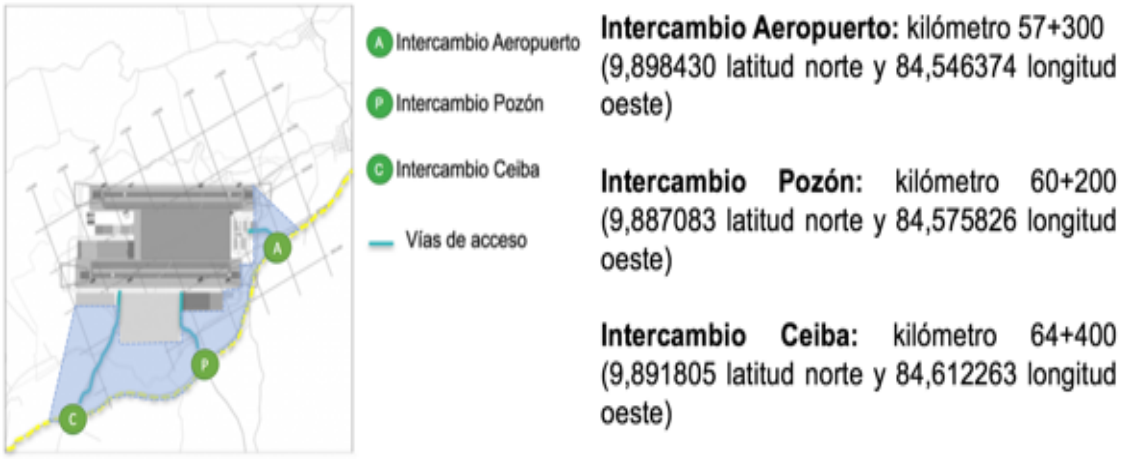


Source: Mott MacDonald

Proposed connecting points

Three access have been identified in order to separate the industrial and passenger demand.

Figure 5.17 Proposed connecting points to the NAIMCR.



Source: Mott MacDonald

The impact on the main access, Ruta 27, has been analysed following the passenger catchment by the rail mode which is described in the next section. (the table below provides only 0% and 15% of catchment).

The main report contains the full tables based on the different traffic scenarios for the airport (low, base and optimistic).

The tables contain demand and recommend a number of spurs to be constructed.

Table 5.2 shows a sample so reader should refer to the main report and its appendices for full and comprehensive details.

Table 5.2 Number of vehicles accessing the NAIMCR (0%, 15% and 20% using the train)

Posible Impact on Highway 27																			
Section 31+500 - 53+500																			
Year	Peak Hour Current Volume	Without Train						Capture 15% of traffic						Capture 20% of traffic					
		Peak hour passenger numbers	Employee Peak Hour Volume	O/D Volume at Peak hour	Total Volume	Spurs required in each direction in RN 27	Spurs to be constructed each direction in RN 27	Peak hour passenger numbers	Employee Peak Hour Volume	O/D Volume at Peak hour	Total Volume	Spurs required in each direction in RN 27	Spurs to be constructed each direction in RN 27	Peak hour passenger numbers	Employee Peak Hour Volume	O/D Volume at Peak hour	Total Volume	Spurs required in each direction in RN 27	Spurs to be constructed each direction in RN 27
2015	1036	1469	530	1162	2198	1	0	1259	450	993	2029	1	0	1185	424	935	1970	1	0
2016	1085	1604	627	1304	2389	1	0	1374	533	1114	2199	1	0	1293	502	1048	2133	1	0
2017	1137	1682	693	1392	2529	1	0	1441	589	1189	2326	1	0	1356	554	1119	2256	1	0
2018	1191	1761	760	1481	2673	1	0	1508	646	1265	2457	1	0	1419	608	1191	2382	1	0
2019	1248	1839	828	1571	2820	1	0	1575	704	1342	2590	1	0	1482	662	1263	2511	1	0
2020	1308	1878	895	1640	2948	1	0	1608	760	1400	2708	1	0	1514	716	1318	2626	1	0
2021	1370	1956	962	1730	3100	1	0	1676	818	1477	2847	1	0	1577	770	1390	2761	1	0
2022	1436	2034	1029	1819	3255	1	0	1743	874	1553	2989	1	0	1640	823	1462	2898	1	0
2023	1505	2113	1095	1908	3412	1	0	1810	931	1629	3134	1	0	1703	876	1533	3038	1	0
2024	1577	2191	1161	1997	3573	2	1	1877	987	1705	3281	1	0	1766	929	1605	3181	1	0
2025	1652	2269	1228	2086	3738	2	1	1944	1044	1781	3433	1	0	1829	982	1676	3328	1	0
2026	1714	2347	1295	2175	3890	2	1	2011	1101	1857	3572	2	1	1892	1036	1748	3462	1	0
2027	1779	2465	1363	2286	4065	2	1	2111	1158	1952	3731	2	1	1987	1090	1837	3616	2	1
2028	1846	2543	1430	2376	4222	2	1	2178	1215	2028	3875	2	1	2050	1144	1909	3755	2	1
2029	1916	2621	1499	2467	4383	2	1	2245	1274	2106	4022	2	1	2113	1199	1982	3898	2	1
2030	1989	2739	1569	2579	4568	2	1	2346	1333	2202	4190	2	1	2208	1255	2072	4061	2	1
2031	2064	2817	1628	2663	4726	2	1	2413	1383	2273	4337	2	1	2271	1302	2139	4203	2	1
2032	2142	2895	1687	2746	4888	2	1	2480	1434	2345	4486	2	1	2334	1349	2207	4348	2	1
2033	2223	2973	1746	2830	5053	2	1	2547	1484	2416	4639	2	1	2397	1397	2274	4497	2	1
2034	2307	3052	1806	2915	5222	2	1	2614	1535	2489	4795	2	1	2460	1445	2342	4649	2	1
2035	2394	3130	1867	3000	5394	2	1	2681	1587	2561	4955	2	1	2523	1494	2410	4804	2	1
2036	2461	3247	1929	3107	5567	2	1	2781	1639	2652	5113	2	1	2618	1543	2496	4957	2	1
2037	2529	3326	1991	3192	5721	2	1	2848	1692	2725	5254	2	1	2681	1593	2565	5094	2	1
2038	2599	3404	2054	3279	5879	2	1	2915	1746	2799	5399	2	1	2744	1643	2635	5234	2	1
2039	2672	3521	2118	3388	6059	2	1	3016	1800	2892	5563	2	1	2838	1695	2722	5393	2	1
2040	2746	3599	2183	3476	6221	2	1	3083	1856	2967	5713	2	1	2902	1746	2792	5538	2	1
2041	2822	3678	2249	3564	6386	2	1	3150	1911	3042	5864	2	1	2965	1799	2863	5685	2	1
2042	2901	3795	2314	3673	6574	2	1	3250	1967	3135	6036	2	1	3059	1851	2951	5852	2	1
2043	2981	3912	2381	3784	6765	2	1	3351	2024	3230	6211	2	1	3154	1905	3040	6021	2	1
2044	3064	3991	2448	3873	6937	2	1	3418	2081	3306	6370	2	1	3217	1958	3112	6176	2	1
2045	3149	4108	2517	3985	7134	3	2	3519	2139	3401	6551	2	1	3312	2013	3201	6351	2	1
2046	3205	4186	2586	4075	7281	3	2	3586	2198	3479	6684	2	1	3375	2068	3274	6479	2	1
2047	3262	4304	2655	4188	7450	3	2	3686	2257	3574	6837	2	1	3469	2124	3364	6627	2	1

Source: Mott MacDonald

5.3.2 Rail:

Investment plans for the railway mode

It is planned to improve and recover the railway mode. The team has considered this will be carried out in three stages.

- Stage I: Enabling the network from the national stadium to Paraíso de Cartago.
- Stage II: Enabling the network from the Atlántico station to Alajuela.
- Stage III: Enabling the network from the national stadium to Alajuela.

It is proposed to add branch to Orotina to the stage III with capacity for passengers and cargo. The branch should join the airport infrastructure at the proposed exchanger 'A' (for passengers) and then continue towards the Pacific and reaching Puerto Caldera.

Demand

The selection of the railway mode by the passengers using the airport will depend on many factors, amongst which the following are highlighted:

- Frequencies and destinations available
- Time of travel compared to road mode
- Travel costs

Given the level of definition of railway investments, the consulting team has compared the use of the rail mode with other modes of transport (public and private) in other airports and countries as shown in the figure:

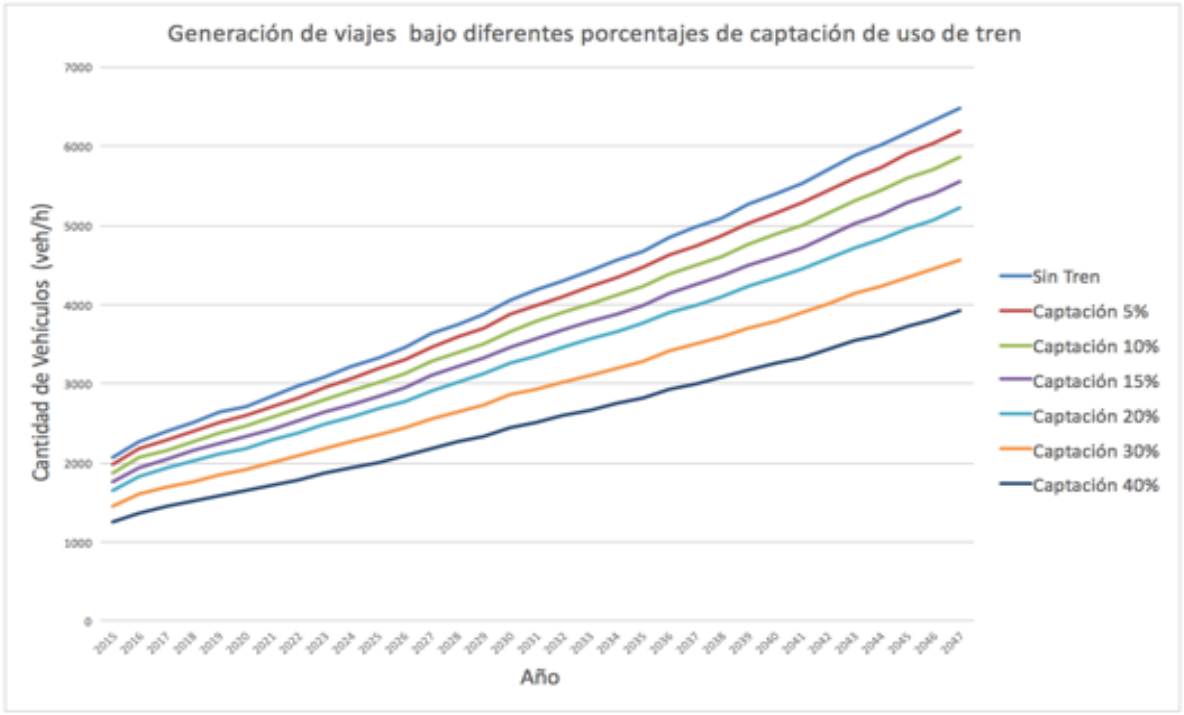
Table 5.3 Transport modes at different airports

Airport (year of modal split)	Private		Public		Other	Passengers (million) in year of modal split	Passengers 2014 (million)
	Car	Taxi	Rail/Metro	Bus			
Hong Kong (2005)	7%	13%	24%	47%	9%	40.7	63.2
Shanghai Pudong (2008)	49%		6%	45%		28.2	51.7
Tokyo Narita (2008)	41%		36%	23%		33.5	35.6
Amsterdam (2014)	40%	9%	39%		12%	55	55
Brussels (2009)	51%	19%	17%	11%	2%	17	21.9
Copenhagen (2009)	24%	17%	55%	3%	1%	19.7	25.6
Dusseldorf (2009)	58%	20%	19%	1%	2%	17.8	21.9
Frankfurt (2012)	37%	19%	36%	6%	2%	57.5	59.6
Geneva (2008)	72%		21%	7%		11.5	15.2
Leipzig (2006)	72%	10%	13%	5%		2.34	2.33
Madrid (2009)	30%	30%	32%	6%	2%	48.2	41.8
Munich (2014)	44%	12%	31%	13%		39.7	39.7
Oslo (2009)	31%	5%	44%	19%	1%	19.1	24.3
Paris Charles de Gaulle (2009)	28%	27%	32%	11%	2%	57.9	63.8
Paris Orly (2009)	35%	29%	19%	16%	1%	25.2	28.9
Singapore Changi	23%	48%	16%	11%	2%	54	54
Stockholm (2009)	34%	19%	28%	19%		16.1	22.4
Vienna (2008)	59%		41%			19.7	22.5
Zurich (2008)	53%		42%	5%		22.1	25.5

Source: Mott MacDonald

The transport mode study allowed to generate hypotheses for access to the airport. This has been measured in number of vehicles depending on the train mode share as shown in the figure:

Figure 5.18 Number of vehicles at NAIMCR



Source: Mott MacDonald

In the case under analysis the profitability of rail access, the difference between 0% of catchment and the estimated catchment percentage according to the efficiency of the mode of rail transport (i.e. 15% of catchment), immediately produces the number of passengers and employees who uses the "train" mode.

At a master planning stage, it has been considered that a certain number of passengers will use the train to get to the airport. For this reason, a modal-interchange station and associated access have been included in the plan.

6 Activity 4. Facility Requirements

This activity presents the facility requirements developed based on the demand output from the air traffic defined in Activity 2. The analysis of each element is mainly based on the peak hour demand, annual passengers, or annual movements. The capacity demand analysis has been carried out for each phase considered in the Master Plan.

To carry out the sizing of the facilities at a master planning level, a set of documents and guidelines such as the following have been used: ICAO annexes and manuals, advisory circulars and pertinent orders of the United States Federal Aviation Administration (FAA), documents and other important sources of the Airports Cooperative Research Program (TRR), IATA's Airports Development Reference Manual (ADRM), the National Fire Protection Association (NFPA), and the Council International Airport (ACI), among others.

According to Costa Rican government intentions, NAIMCR is expected to enter into operation by the year 2027. Thus, the year 2027 is the Initial State of the NAIMCR.

The NAIMCR planning horizons according to the request for proposal are the following:

- Short term or 5 years after opening day;
- Medium term or10 years after opening day;
- Long term or 20 years after opening day.

A scenario of Maximum Development has been also considered. This is not necessarily linked to a time scale (20XX) but is one that ensures that development is not exhausted at 20 years, but may continue to develop in time probably to a horizon of more than 50/60 years that allow a reasonable amortization of infrastructure.

Based on this, Activity 4 of the master plan study develops the requirements for the following:

- Requirements for the geographical characterization of the site
- Aircraft manoeuvring area
- Aircraft aprons
- Passenger terminal
- Cargo terminal
- Landside Access and parking
- Air Navigation Requirements
- Aircraft rescue and firefighting services (ARFF)
- Support Facilities
- Ancillary Facilities

For each of them, a demand expressed in the unit most suitable for planning purposes has been estimated numerically, so that the infrastructure needs can be determined based on this at a master planning level for the purposes of the study. The infrastructure needs are then pictured in a land use plan.

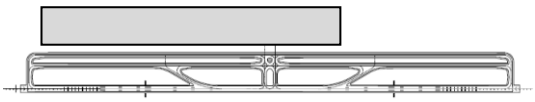
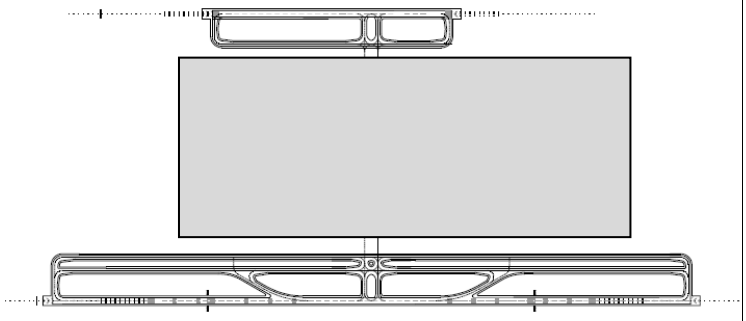
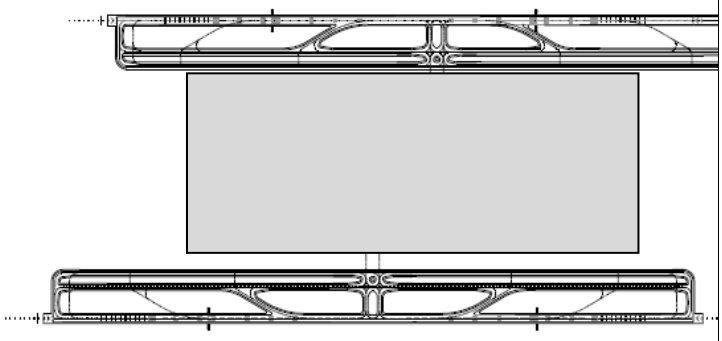
In summary, this activity contains the Demand that will generate the forecasted traffic at the airport as well as the requirements in order to be able to attend to the provision of sufficient capacity. The infrastructure needs are further developed in later activities.

The result of this chapter is a needs or requirement schedule that lists, in a numerical form, the capacity required during the different stages. Some examples are:

6.1 Runways:

For the runways the following requirements are set:

Table 6.1 Summary of runway configuration requirements

Basic Configuration	Capacity	Life span
Single runway (Rwy 1) category F Rapid exit taxiway for Code C for both conFiguretions Independent parallel taxiway Second parallel taxiway (optional) Independent inner taxiway, dual when over 8 stands 	43-45 peak hour movements	2032 base case (43 peak hour movements) or 2037 base case (45 peak hour movements), pending on airspace
Parallel runway for Code A y B aircraft, compatible with future development (Rwy 2) Full parallel taxiway, compatible with future development 	Up to 48 peak hour movements for rwy 1 and 43 for rwy 2	Provides capacity for the 3 phases (base case)
Rwy 2 extended to full length (parallel runways F+E or F+F) with RET for C, B y E in all conFiguretions, By-pass at each runway end, cross field taxiway links between runways, independent operations, CAT I operations all conFiguretions. 	80-90 (85 movements peak hour)	Provides capacity for Maximum Development

6.2 Commercial Aircraft Aprons:

Table 6.2 Commercial stand requirements.

	Unit	BASE ESCENARIO BC 2027	FASE I ESCENARIO BC 2032	FASE II ESCENARIO BC 2037	FASE III ESCENARIO BC 2047	FASE III ESCENARIO HC 2047
STAND REQUIREMENTS						
Code A						
Contact		0	0	0	0	0
Remote		0	0	0	0	0
Code B						
Contact		0	0	0	0	0
Remote		11	12	13	14	16
Code C						
Contact		16	19	22	29	33
Remote		5	7	7	7	10
Code D						
Contact		1	0	0	0	0
Remote		0	0	0	0	0
Code E * Outside Peak Hour - Uses MARS Positions						
Contact		2	2	2	3	3
Remote		0	0	0	0	0

Source: Mott MacDonald

MARS –Multiple Apron Ramp System foreseen will provide stands for Code E aircraft outside the peak hour.

6.3 Passenger Terminal:

With regards to the area requirements for the passenger and cargo terminals, these requirements have been processed in compliance with the ADRM 10 Manual published by IATA, and a summary of the area requirements according to the different traffic horizons in tables 6.3 y 6.4:

Table 6.3 Passenger Terminal Requirements

AREA CALCULATIONS		2015	2027	2032	2037	2047	2047
Phase		EXISTENTE	BASE BC	FASE 1 BC	FASE 2 BC	FASE 3 BC	FASE 3 HC
Secondary Functions Areas - Domestic							
Lounges Area	m²	0	272	257	300	357	377
Terminal Operations Office Area	m²	0	136	128	150	178	189
Airlines Offices Area	m²	0	340	321	375	445	472
Misc. Government Offices Area	m²	0	204	192	225	268	283
Ground Handling Services Area	m²	0	272	257	300	347	377
Engineering Facilities Area	m²	0	68	64	75	89	94
Misc. Secondary Facilities Area	m²	0	68	64	75	89	94
Airport Operation Control Center Area	m²	0	68	64	75	89	94
Ramp Control Tower Area	m²	0	68	64	75	89	94
Loading Dock + Storage Area	m²	0	68	64	75	89	94
Passenger Amenities Area	m²	0	136	128	150	178	189
Green and Outdoor Spaces Area	m²	0	68	64	75	89	94
Total Secondary Functions Areas	m²	0	1,767	1,668	1,950	1,319	2,452
Total Program Areas							
Total Program Areas International	m²	13,494	68,753	73,278	82,733	108,735	129,838
Total Program Areas Domestic	m²	0	8,562	7,951	9,272	11,013	11,883
Total Program Areas	m²	13,494	77,315	81,362	92,181	111,971	141,721
Service Areas - International							
Circulation Area	m²	16,200	15,489	16,488	18,615	24,015	29,214
MEP Area	m²	0	10,313	14,556	16,457	21,347	25,968
Structure and Partitions Area	m²	0	2,083	4,397	4,954	6,404	7,790
Vertical Circulations Cores Area	m²	513	2,083	7,328	8,273	10,674	12,984
Total Service Areas	m²	16,713	28,965	42,267	47,720	61,546	75,060
Service Areas - Domestic							
Circulation Area	m²	0	1,925	1,819	2,126	2,528	2,674
MEP Area	m²	0	1,712	1,617	1,890	2,247	2,377
Structure and Partitions Area	m²	0	514	485	557	674	713
Vertical Circulations Cores Area	m²	0	856	808	945	1,124	1,188
Total Service Areas	m²	0	5,009	4,729	5,527	6,573	6,951
TOTAL TERMINAL AREA							
TOTAL AREA INTERNATIONAL	**m²**	**30,207**	**98,661**	**116,146**	**131,132**	**169,175**	**205,794**
TOTAL AREA DOMESTIC	**m²**	**0**	**13,571**	**12,813**	**14,975**	**17,809**	**18,834**
TOTAL TERMINAL AREA	**m²**	**30,207**	**112,232**	**128,958**	**146,107**	**186,984**	**224,628**

Source: Mott MacDonald

Figure 6.1 Artistic impression of terminal building access of the NAIMCR

Source: Gensler

6.4 Cargo Terminal:

Table 6.4 Cargo terminal requirements

Year	2027	2032	2037	2047	2047	MD
Phase	Opening	Fase I base case	Fase II base case	Fase III base case	Fase III high case	Maximum Development
Cargo (tn)	115.240	138.540	165.210	232.980	249.160	647.816
Cargo storage (m2)	11.525	13.855	16.520	23.300	24.915	64.779
Cargo CTMR (m2)	2.305	2.770	3.305	4.660	4.985	12.961
Total (m2)	13.830	16.625	19.825	27.960	29.900	77.740

Source: Mott MacDonald

6.5 Ancillary facilities:

In the same way, the rest of the infrastructure required has been sized and the results entered in the main body of the report.

These include details of Air Space and Navigational aids, procedures, TWR, Crash Fire and Rescue Service, Aircraft Maintenance, General Aviation, Police, Fuel, Water Treatment and Potable Water, electricity and roads, parking, and other facilities.

To see further details please refer to the main report.

7 Activity 5. Airport Development Optioneering

A set of airport development options has been developed based on the demand requirements analyzed on the previous activity (activity 4). Different options were developed for a list airport components. These have been brought together in 3 main alternatives that have been analyzed, ranked based on a set of parameters and discussed with the Client. As outcome of these, a preferred development solution has been selected. This is the one developed in more detail in Activity 6 and Activity 7.

This development is based on 4 fundamental premises:

Figure 7.1 Development objectives

Source: Mott MacDonald

Given that the runways setting out is considered fixed as a result of the airspace analysis (moving the thresholds would entail limitations to aircraft operations), the component that has a bigger impact on the optioneering exercise is the passenger terminal typology.

The terminal typology shapes the configuration of the aircraft apron, the cargo terminal and ultimately, the locations of the auxiliary facilities. Therefore, the optioneering process starts with the definition of different passenger terminal arrangements.

The optioneering process has been developed following an iterative process of continuous improvement amongst the team. The proposed alternatives have been analyzed by each

specialist, starting with the passenger terminal, passing through to the airfield experts and the support/ancillary specialists and back to the architects and landside planner again. Several rounds were completed until the three options were finally defined.

These resulting alternatives are studied firstly for the maximum development (MD), thus safeguarding sufficient spaces for future development without constraints. At the same time, the opening layout and phased development has been taken into account using the master planning common practice.

Once the alternatives are defined, the layouts are then evaluated against the qualitative and quantitative criteria. The criteria and ranking of the options is discussed with the Client. A preferred alternative is selected. This is the alternative to be further developed in the Master Plan.

Figure 7.2 Passenger terminal options and typologies

Source: Mott MacDonald

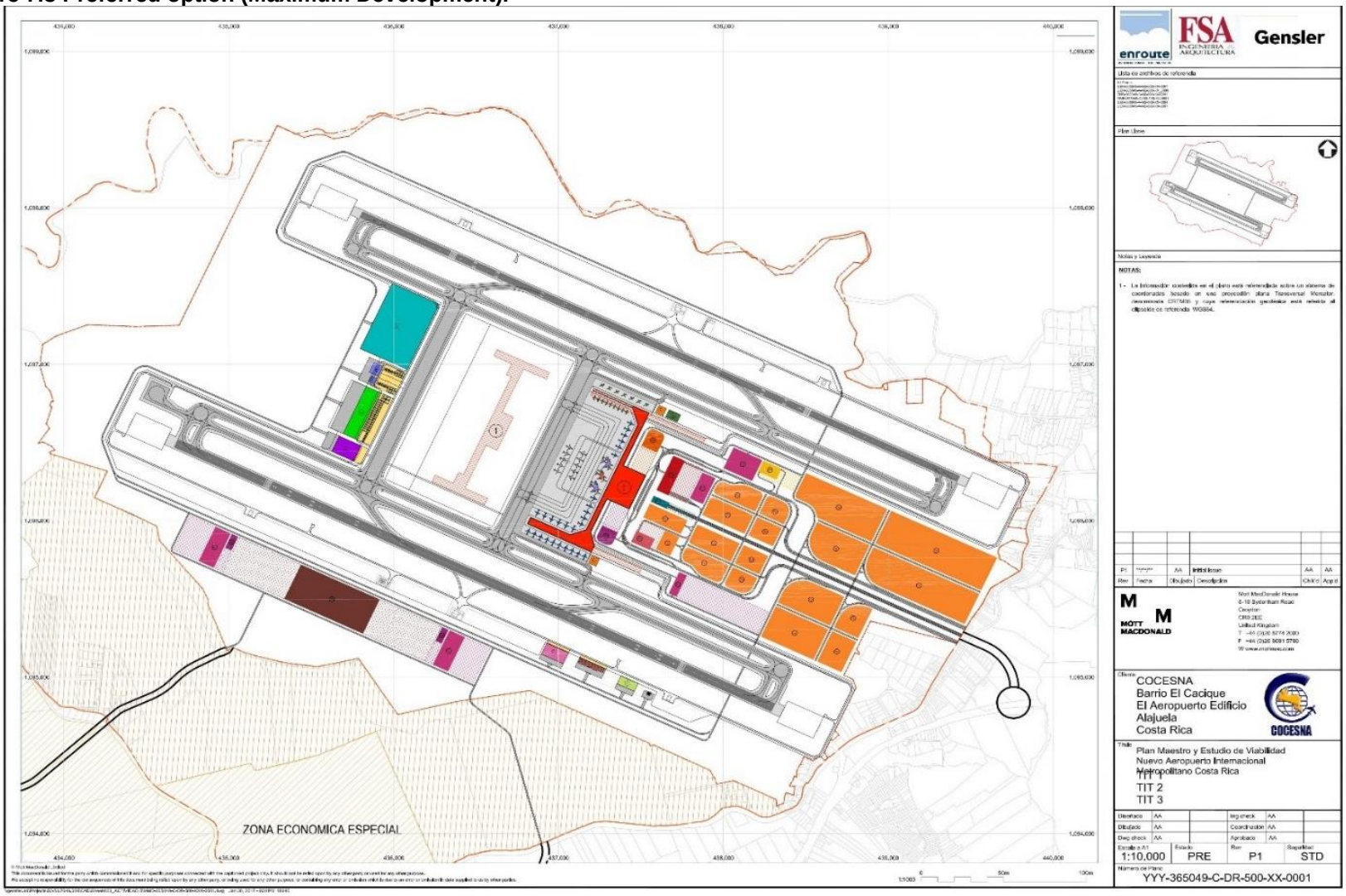
The results obtained by the selection process are contrasted with the environmental and operational limitations evaluating the impacts and their mitigations. The scoring and raking have been discussed and agreed during a workshop with the Client. The Consultant concluded with a preferred alternative which is the passenger terminal in modified "H" conFiguretion (Bottom row / center row in the figure).

For the selected passenger terminal alternative, a set of options for the elements of lower hierarchy items was carried out to produce the maximum airport development layout. This ensures that over the time the elements do not interfere with each other. The Activity 5 report analyzes in more detail the different aspects that led to the proposed alternative.

It should be emphasized that given the long development period (50 to 80 years), it has been considered that some facilities would be re located in the long term to accommodate the passenger expansion with satellite buildings. The short-term location is analyzed based on operational efficiency and capex considerations.

With the option selected in Activity 5 and the demand requirements analyzed in Activity 4, the Consultant proceeded to complete the master plan development for the NAIMCR in Activity 6 according to Contract.

Figure 7.3 Preferred option (Maximum Development).



Source: Mott MacDonald

Figure 7.4 Evaluation matrix – Passenger Terminal

EVALUATION CRITERIA	DEVELOPMENT OPTIONS		
	OPTION 1 Perpendicular Pier	OPTION 2 Central Processor	OPTION 3 Multiple Terminals
1.0 Passenger Terminal			
1.1 Clarity and simplicity of passengers movements			
1.2 Distance to access aircrafts			
1.3 Access to all amenities and concessions			
1.4 Domestic passengers experience			
1.5 Simplicity of domestic flight connections			
1.6 USA Preclearance			
1.7 Earth movements and area occupied			
2.0 Apron			
2.1 Proximity of the aircraft stands to the RWY			
2.2 Presence of difficult manoeuvre			
2.3 Flexibility in providing manoeuvring options			
2.4 Distance to the terminal from remote positions			
2.3 Flexibilities in gate configurations			
2.4 Upgrade south taxiway to code F			
3.0 Phases			
3.1 Possibilities to built the terminal in phases			
3.2 Possibility of adapting to changes in demand			
3.3 Impact of the phases on the functionality of the terminal			
3.4 Impact of the phases on the shape of the terminal			
3.5 Access to the MD expansion area			
4.0 Land side Access and configuration			
4.1 Clarity and simplicity of the access road			
4.2 Passengers experience			
4.3 Land side configuration efficiency			
4.4 Earth movements			
4.5 Impact of the phases			
5.0 Cost			
5.1 Impact of the configuration on the total cost			
5.2 Impact on the initial investment			
5.3 Land side access cost			
5.4 Earth movements cost			
5.5 Impact of the phases			
6.0 Operations			
6.1 Efficient passengers operations			
6.2 Efficiency in the processing of luggage			
6.3 Efficiency in the transferring and distribution of baggages			
6.4 Efficiency in land side operations			
6.5 Efficiency in air side operations			
6.6 Control Tower visual observation			
6.7 Airport security			
Total (Average)	**2.83**	**2.09**	**2.34**

Source: Mott MacDonald

Figure 7.5 Evaluation Matrix – Cargo Terminal

CARGO TERMINAL

Criterion	Option 1	Option 2	Option 3
Provision of necessary capacity	3	3	2
Air side access	2	2	1
Land side access	3	3	2
Ease of future expansion	3	2	1
Possibilities of expansion	3	3	2
Integration with future developments	2	2	1
Environmental impact	2	2	2
TOTAL (average)	2.57	2.42	1.42

Source: Mott MacDonald

Figure 7.6 Artistic impression of the airport at its maximum development

Fuente: Gensler

8 Activity 6. Development Plan

This starting point of this activity is the facility requirements developed during Activity 4 and the selected preferred development alternative according to Activity 5. Based on this, the Consultant has refined the selected maximum development alternative and produced the NAIMCR development plan. The objective of the task is to present the master plan phasing of the airport.

The phasing analysis starts with the proposed maximum development of the terminal, the airfield, and support facilities. The layouts for the Opening +5 years, +10 years and +20 years are then produced based on the capacity demand analysis for each horizon.

In this regard, it is important to reiterate the view that this airport is not only an airport for the next 30 years (until 2047), but that must be the infrastructure that welcome air transportation in the country far beyond the contractual horizon. Therefore, the Consultant has added to the contract the planning of future development horizon. This led to contemplate the development up to a capacity of 50 million passengers per year. With this, the master plan reflects a balanced planning that will allow the survival of the infrastructure beyond 2047 (and perhaps up to the threshold of the new century).

The Development Plan contemplates the passenger terminal, manoeuvring area, supply areas, Airport City, landside access, areas designated for other aeronautical services and air cargo facilities. For the passenger and cargo terminals, flow charts are presented to show the operation feasibility.

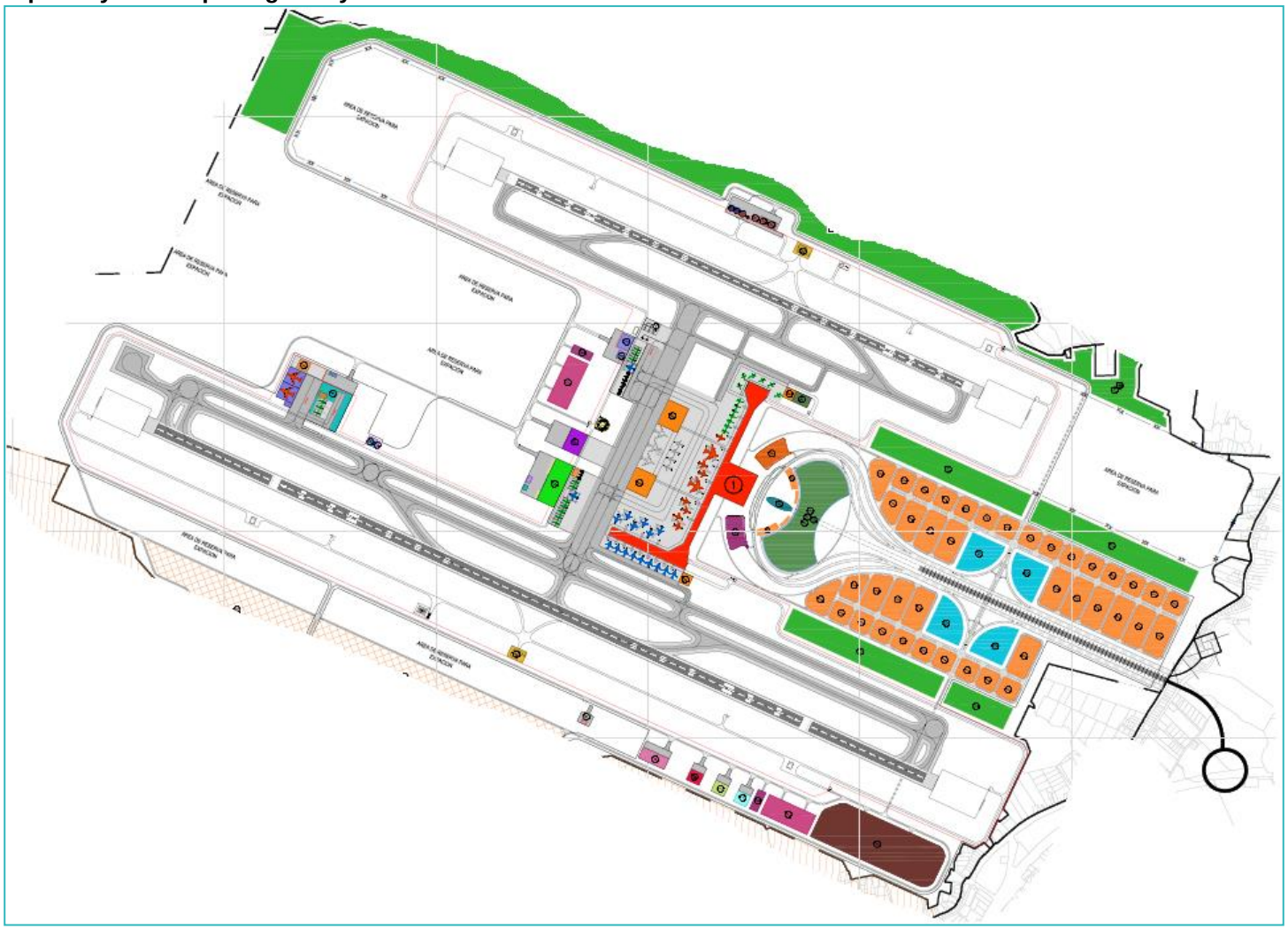
In addition to this, a noise impact and emissions assessment have been carried out for each development phase. This will inform later stages of the project helping to make a decision over environmental and social safeguarding.

The development of the airport for the planned horizons is shown in the following images:

Figure 8.1 Airport layout at Opening + 5 years

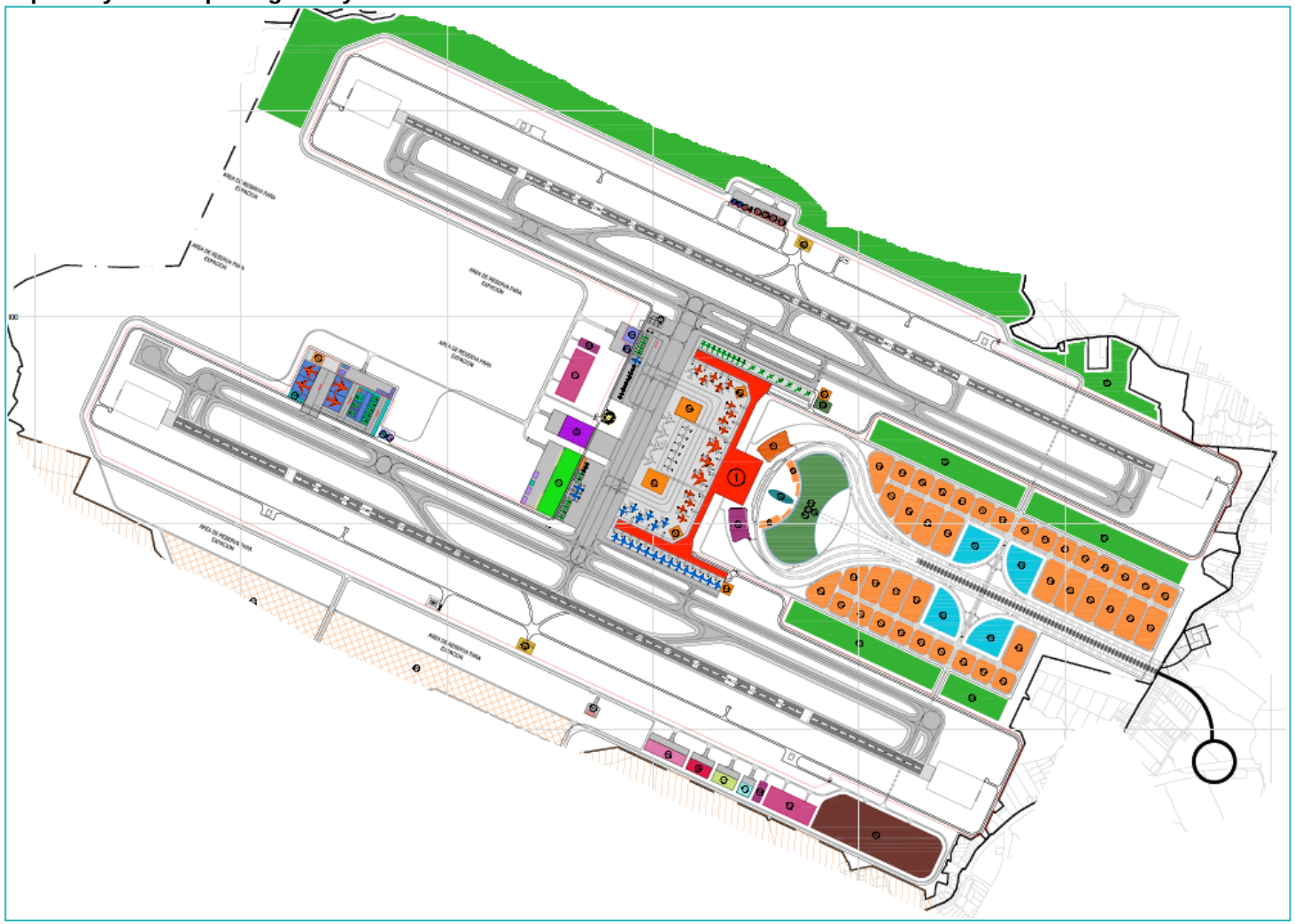
Source: Mott MacDonald

Figure 8.2 Airport layout at Opening + 10 years



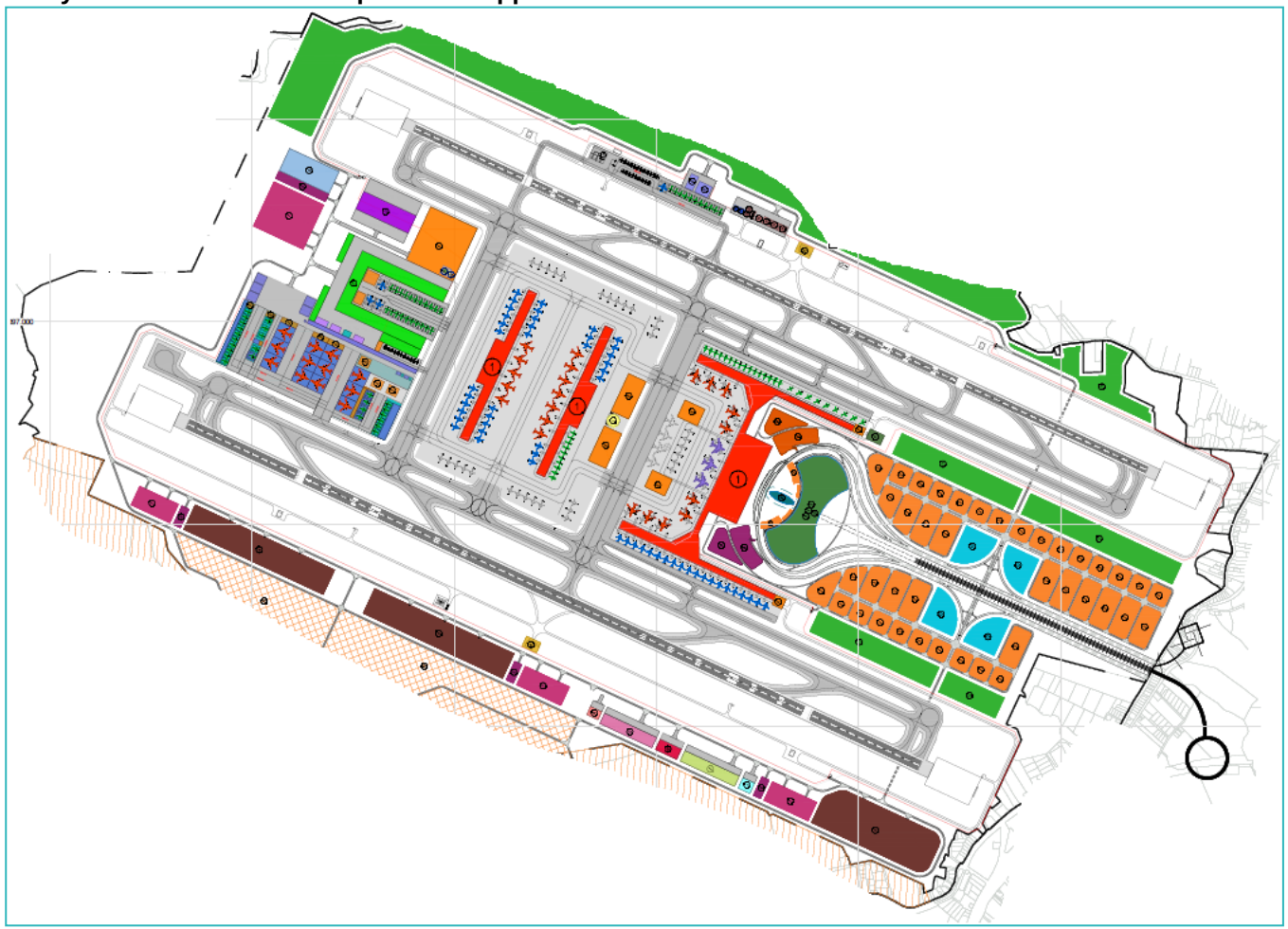
Source: Mott MacDonald

Figure 8.3 Airport layout at Opening + 20 years



Source: Mott MacDonald

Figure 8.4 Airport layout at Maximum Development 50 mppa.



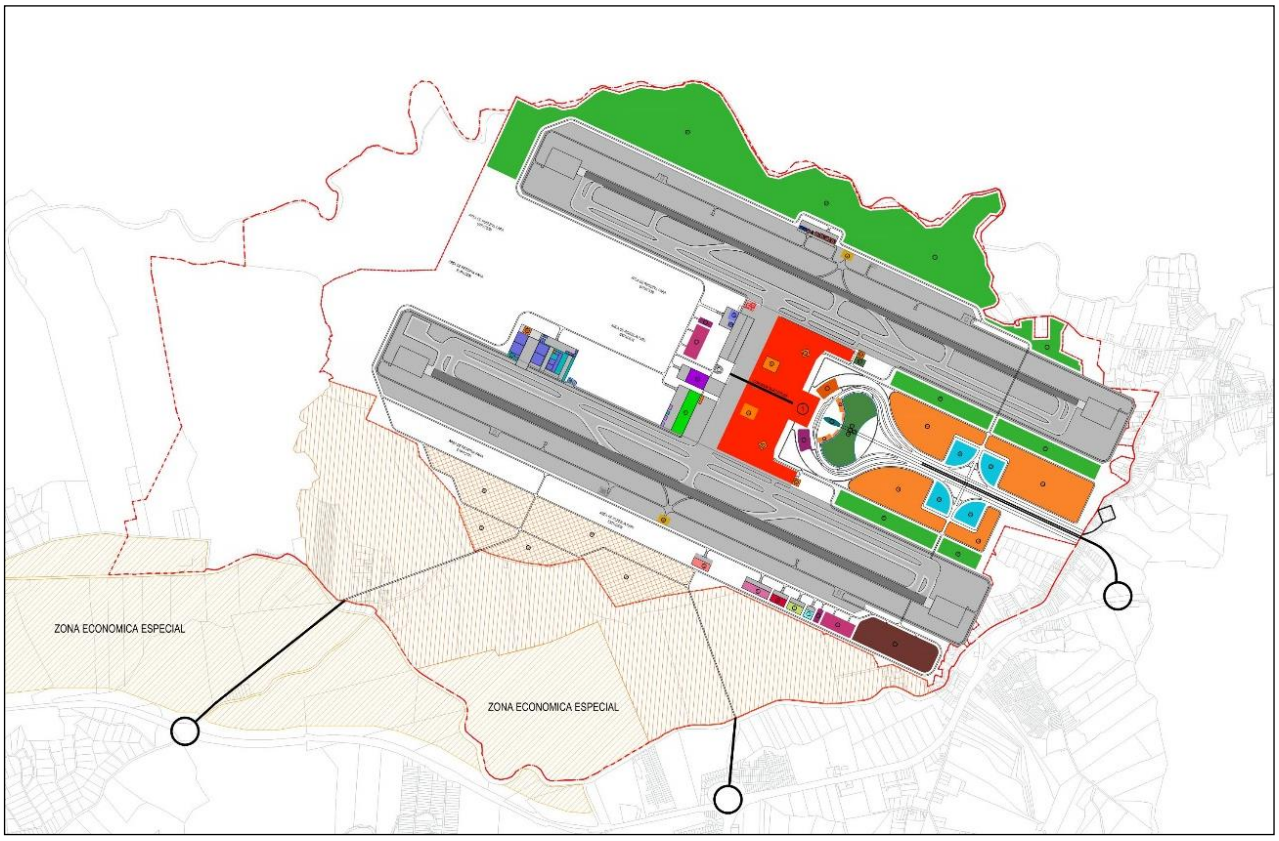
Source: Mott MacDonald

It has been highlighted that, the landside access and utilities outside the airport boundary are a must for the development of the airport. These have to be developed in parallel to the NAICMR for it to be efficient and profitable.

The technical report closes out with a review of the land use. The appendices of the report contain the airside simulation results carried out with the software SIMMOD and the airport development drawings, terminal concepts, noise and emissions impact drawings and affected public services.

An initial set of 3D visualizations have been produced. These show the magnitude of the works and the primary area of involvement (land that is recommended to be acquired and integrated within the boundary of the airport), and a secondary area for related activities whose property would continue in the hands of the private owner, but whose land uses should be regulated as industrial or mainly to activities related to the use of the airport.

Figure 8.5 Land use map for 2047.



Source: Mott MacDonald

9 Activity 7. Preliminary Business Plan

Activity number 7 develops the Preliminary Business Plan based on the master plannning activities developed in steps 1 to 6.

These results can be summarised in the following table:

Table 9.1 Passenger terminal area, annual traffic and design year, passenger terminal opening year.

			Design Year			Opening Year		
Phase	Terminal m2	Traffic mppa	Pesimistic case	Base case	Optimistic case	Pesimistic case	Base case	Optimistic case
I	128,958	9.80	2,037	2,032	2,026	2032	2027	2021
II	146,107	11.40	2,043	2,037	2,030	2,038	2,032	2025
IIIa	186,984	15.20	2,058	2,047	2,040	2,053	2,042	2,035
IIIb	224,628	20.10	N/A	2,060	2,049	N/A	2,055	2,044

Source: Mott MacDonald

These figures guide the development in stages and they are used with the appropriate breakdown of works (see main body of report) to investigate the cost of the development.

9.1 CAPEX

The initial calculations including the earthworks costs resulted in an estimated investment of US$2,322,421,261 for the initial phase, and a total investment of US$3,584,452,000 for all phases.

In following iterations, these costs were optimized mainly in terms of the unit costs of the earthworks. This was based on experience from similar projects in terms of the required volume and the construction methodology and costing. It was concluded that the cost of the infrastructure described in the master plan for each phase can be summarized according to the table below:

Table 9.2 Investment optimised by phase

	Preliminary activities	Phase 1	Phase 2	Phase 3	Total
Land acquisition	41,312,581	0	0	0	41,312,581
Groundworks	0	533,771,229	172,485,761	141,669,309	847,926,299
Terminal	0	596,773,800	88,944,030	142,298,730	828,016,560
Airside infrastructure	0	509,533,788	110,177,060	133,235,242	752,946,089
Airside buildings	0	52,060,277	26,680,500	42,078,960	120,819,737
Utilities	0	86,327,526	11,540,315	24,573,389	122,441,230
Landside	0	130,820,601	15,367,319	91,715,318	237,903,238
Off-airport commercial area	0	23,421,857	0	0	23,421,857
Total	41,312,581	1,932,709,077	425,194,985	575,570,948	2,974,787,591

Source: Mott MacDonald

Land acquisition costs are indicative and according to entries in the land registrar, but its value when acquired by the State will need to be determined following the administrative procedures because of the potential economic activities that could be affected and would need to be compensated, this could in fact increase the value.

These costs were calculated to 2017 rates, so in order to use them in the financial model they need to be carried forward using an estimated rate of inflation so all costs in the model are considered at a base date of 2022 that is when the consultant has estimated that financial close will occur.

9.2 Implementation Strategy

In order to materialize the proposed infrastructure there are several implementation alternatives:

- Execution by Public Works (PW) – Public Sector Financing
- Hybrid execution – Public Private Partnership (PPP):
  - Earthworks (PW) / Construction (PPP)
  - Earthworks + Airside infrastructure (PW) / Terminal (PPP)
- Total execution as PPP –Private Financing

The Government of Costa Rica has requested that this study is based on the total private financing alternative.

9.3 Financial Model and Business Plan

The fact that the client wants to investigate 100% private financing leads to construct a business model that considers private equity and 70% finance of the investments.

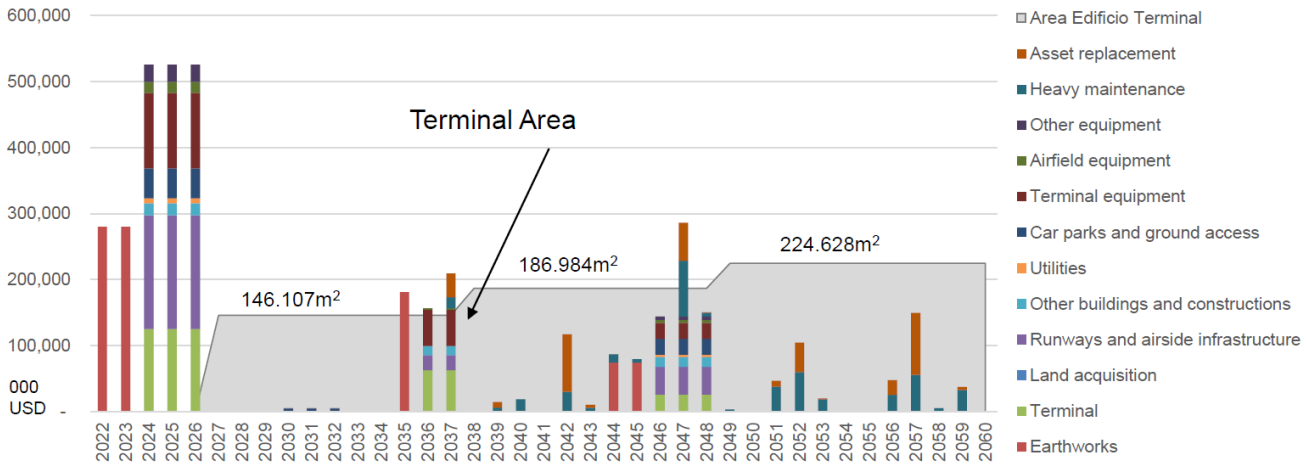
It should be noted that the resulting circa 17% reduction in required investment in is not enough to make the project viable, and several financial aspects were considered to base our recommendation of an increase in aeronautical tariffs above the current level. Additionally, the recommendation includes and applicable pre-financing tariff during the construction phase that is set to last five years in the preliminary business plan. Our recommendation also includes allowing the Duty Free to be managed by an international operator at the new airport.

In order to service the debt, it was necessary to sculpt the capex to be able to have a 5-year period from the commencement of operations. The proposed sculpting involves the consolidation of Phases I and II at the beginning of the PPP period.

This requirement leads to the consolidation of phases 1 and 2 into the opening of the APP.

In figure 9.1 it can be observed that opposed to the initial statement in table 9.1, now the opening phase of the terminal building involves the construction of 146,107 sqm instead of 128,958 sqm, so that instead of expanding the terminal after 5 years, the required expansion falls 10 years after opening and thus provides a longer period of debt servicing before requiring a re-financing for the new expansion.

Figure 9.1 Investment Programme necessary to achieve 100% PPP finance



Source: Mott MacDonald

Accepting the previous considerations that are conditions imposed by the capital markets, we have configured the financial model.

The following table summarises the indicative term sheet discussed with several credit entities:

Table 9.3 Indicative term sheet

Amount	70% of initial uses - Capped at $2 billion
Term	Up to 20 years with a tail of 5 years minimum
Rate	Libor + 6% with 1/4 to 1/3 of Swap (Fixed Rate)
Fees	Standard structuring/ arrangement fees between 1.50% and 1.75%, plus commitment fees and prepayment penalties
Debt service reserve account (DSRA)	6 months
DSCR	1.30 to 1.25
Grace period	Up to 5 years (principal and interest)

Source: Mott MacDonald

The results of the financial model show acceptable returns for equity investors that can be summarised in the following table:

Table 9.4 Financial model returns

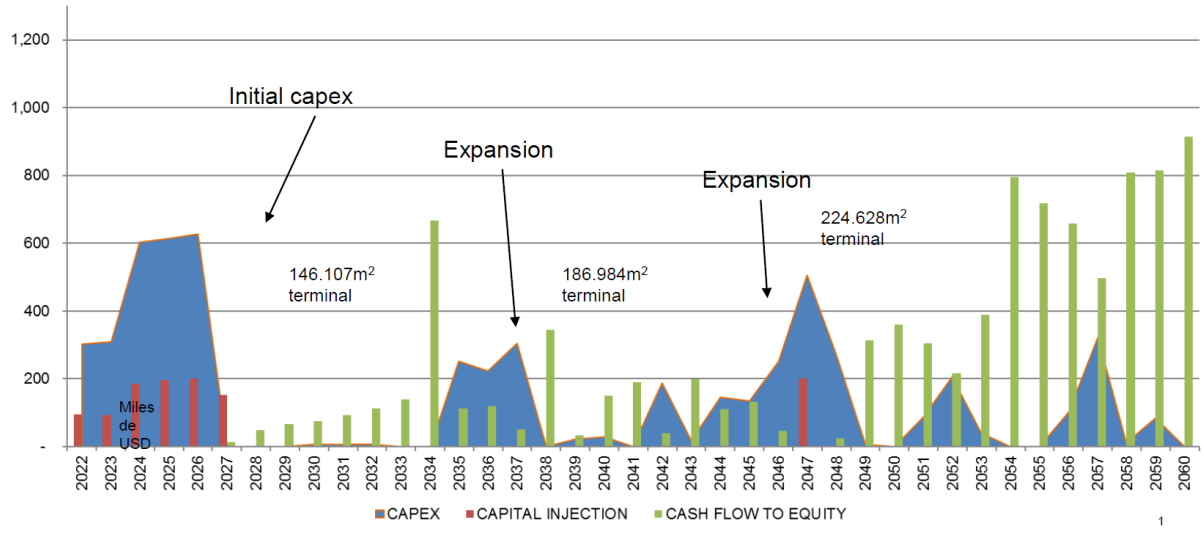
Traffic case	Base
Pre-financing tariff	US$10,00 from 2022 to 2026
Departure fee	US$40,00 from 2027 (Commencement of operations)
Initial investment	US$2.2 billion
Earthworks included	Yes
Duty Free	Managed by IMAS
Initial debt – Amount	US$1.8 billion (70%)
Initial equity	US$770 million (30%)

Initial debt – Term	20 years
Minimun DSCR	1,20x
Maximum Net debt to EBITDA	8,5x
Refinancing	US$1.6 billion (5x EBITDA)
Equity IRR	12.3%

Source: Mott MacDonald

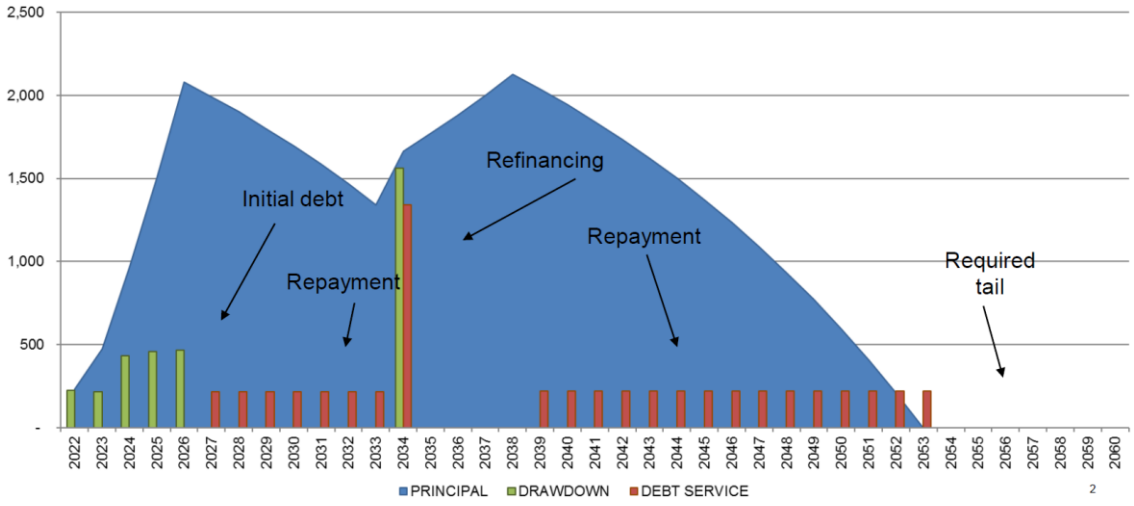
Waterfalls and flows are shown for equity and debt.

Figure 9.2 Investor's flows diagram



Source: Mott MacDonald

Figure 9.3 Debt's flows diagram



Source: Mott MacDonald

The following sensitivities were analysed:

Table 9.5 Sensitivities analysed

Parameters	Values	TIR / DSCR
Pre-financing tariff	$10.00	12.3% / 1,20x [Base Case]
	$9.00	12,15% / 1,19x
	$8.00	12,0% / 1,17x
Departure fee	$40.00	12,3% / 1,20x [Base Case]
	$39.00	11,9% / 1,16x
	$41.00	12,6% / 1,21x
Duty Free	IMAS	12,3% / 1,20x [Base Case]
	Competitive	13,8% / 1,28x

Source: Mott MacDonald

9.4 Feasibility

This case is considered the most likely scenario, and confirms the financial viability of the project. This viability is confirmed both in case of being executed as a Public Works or also under these conditions as financed 100% by private investment

The visualization of the tendencies exhibited by the model with regards to the scenarios tested will allow, in the future, that according to the traffic and market evolution, conclude on the different policies and timing that might be convenient or necessary to maintain the viability of the project.

The model that serves as base for these conclusions is provided with this report.

10 Conclusions

As conclusion of all studies, the feasibility study of the Nuevo Aeropuerto Internacional Metropolitano of Costa Rica (NAIMCR) returns a positive answer. It has been demonstrated that the construction of the NAICMR in the region of Orotina, province of Alajuela, can be developed with Public and Private Participation in accordance to the master plan developed and under observance of the financial parameters presented in the present report.

The NAIMCR site had already been proposed as the most suitable and preferred in different previous studies carried out by other Consultants. The NAIMCR is aimed to replace the current international Juan Santamaria Airport (AIJS). This study confirms the suitability of the selected location and its construction. The NAIMCR could be developed to provide services to more than 50 million passengers a year at the proposed location.

It is also concluded that the Consultant has not observed any excessive difficulties from the point of view of the environment impact, transport connectivity, or utilities that could impede the realization of this project.

It need to be stressed that the expansion of road access as discussed in Activity 3 must be completed before the new airport starts operations.

It is not seen as a disadvantage that the NAIMCR is planned to start operation at the end of the Juan Santamaria international airport Concession agreement expiration.

It rather seems a logical consequence of a process that should not be launched later in the year 2018 considering the need to run a series of preparatory actions. Ultimately, these actions would entail the award through a public-private partnership of a B.O.T. procurement (Build, Operate and Transfer to State) to an investor. The qualification of the investor would have to present satisfactory credentials so that the State of Costa Rica entrusted him the realization of this Proyecto País which requires an investment of two billion dollars in its first phase.

In this case, to make the project feasible, it is a precondition, that the State of Costa Rica adopts the policies required with regards to the type of operations or closure of the other two existing airports, to ensure the investors that the traffic of commercial passengers will materialize at the NAIMCR.

As indicated before, a public private partnership (PPP or P3) would be needed this Project to materialize. The duration of the concession would exceed the initially planned, with a start date in 2022, construction span of five years and concession ending in 2060 (a period of operation of 33 years), i.e. a total of 38-year term.

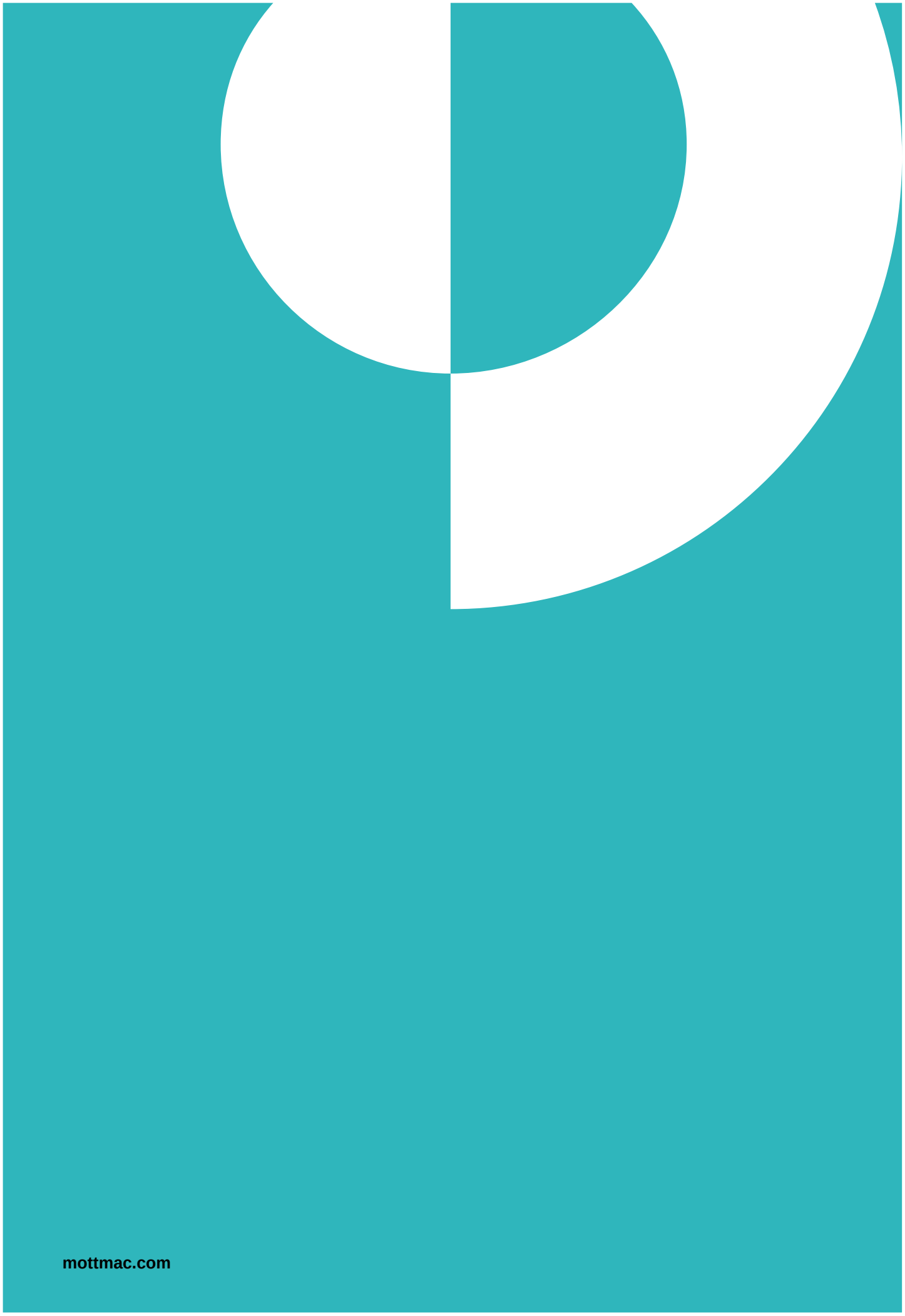
As a function of all the studies, it is concluded that the airport is feasible from the constructive, operational point of view, and it is bankable through a public-private partnership involving 100% of financing from sources other than State budgets.

Below, is the proposed implementation programme.

Figure 10.1 Implementation Schedule

		2018		2019		2020		2021		2022		2023		2024		2025		2026		2027	
Código	Tarea	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
0.1	**Airport**				RfP (May-19)																
	Structuring of PPP (P3) - Tender and Legal docs					Bid submittal (Dec -19)															
	Bidding APP						Contract award (Jul-20)														
	Bid evaluation								Financial closure (Nov-21)												
	Contract agreement and financial closure			Award (Mar-20)																	
	Earthworks									Mobilization and earthworks (Feb-22)											
	Detail Design							Traffic forecast review (Jun-22)						Start construction (Jan-24)							
	Construction										Kick off Detail Design (Jan-23)										
	ORAT																	Opening			
1	**Land acquisiton**																				
	Define Land Use - Legal declaration of Interest		Land use modification (Mar-18)																		
	Land use - airport surrounding		Land use to industrial (Jun-18)																		
	Strategy land acquisition - negotiation			Legal procedures (Nov-18)																	
	Land acquisiton - payment and posecion		Definition of responsibilities and mechanisms (Apr-17)																		
2	**Environmental-Social**																				
	Impact Analysis																				
	EIA - based on declaration of interest			Licensing (Nov-18)																	
	Environmental licensing																				
	EIA approval		Licensing applications (Jun 18)																		
4	**Airspace**																				
	Actualization of Meteorological Data																				
	Analysis and recommendations																				
	Draft Operational procedures planning																				
	Final operational procedures implementation																				
5	**Connectivity**																				
	Road access links review period 2017-19																				
	Planning and design of road links																				
	Construction (in 2 phases)																				
	Rail links review period 2017-22																				
	Planning and design of rail links																				
	Construction (optional)																				
6	**Utilities connection**																				
	Analysis and recommendations																				
	3rd party execution																				
	Communications																				
	Electtricity																				
	Water																				

Source: Mott MacDonald



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